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HUNTING IN NEW YORK: PARTICIPATION, DEMAND AND LAND ACCESS¹

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ABSTRACT

A mail questionnaire was used to survey a sample of 1975-76 New York State resident hunting license holders to gain further insight into hunting participation and hunting access problems. For 6,512 useable questionnaires (64 per cent of those deliverable) returned, the mean age of responding hunters was 39, and their median level of education was 12 years. The majority had spent most of the first 16 years of their lives in rural areas or villages. Land in private ownership provided more hunter days than public lands, and 60 per cent of the respondents indicated they preferred private lands for hunting. In most cases, respondents knew their destination before embarking on a hunting trip, but a notable minority did not. In terms of days afield, the latter amounted to about 16 per cent for big game hunters, 21 per cent for small game hunters and 18 per cent for waterfowl hunters.

Hunting access problems were encountered by 52 per cent of the respondents. About 15 per cent experienced only posting problems, 19 per cent had problems other than posting and 18 per cent had both posting and other access problems. Posting problems were encountered most frequently by pheasant hunters, with those seeking big game, waterfowl and woodcock ranking second. Most hunters reported that they would ask permission to hunt on posted land rather than drive on or deliberately trespass. Two-thirds reported that they would hunt more if more land were available for hunting, the potential increase in hunter days being 34 per cent for big game, 59 per cent for small game and 91 per cent for waterfowl. A slight majority (52 per cent) indicated they would be willing to pay landowners a day-use fee to hunt on private lands. Most respondents were not familiar with the FWMA cooperative program, and only 8 per cent had hunted on an FWMA area in 1976.

Hunting, like most forms of outdoor recreation, requires a great deal of land per recreationist. With the number of licensed hunters in New York approximating 750,000 in recent years, access to rural lands has been in great demand. For many, the availability of sufficient areas of productive game habitat has become the key to successful hunting.

Access to privately owned rural lands in New York has been a major concern for more than 20 years because of the increasing amount of wildlife habitat fringed with "posted" signs. Wildlife managers and

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sportsmen have used the incidence of posted private land as a measure of impediment to hunting access. Waldbauer (1966) found that about 25 per cent of rural private land in New York was posted in 1963. In an update of that study, Brown and Thompson (1976) found that 42 per cent of such lands was posted in 1973—a 68 per cent increase in nine years. This led to further effort by the State Department of Environmental Conservation to determine the extent of access problems encountered by New York's hunters, and it sponsored a new study by the Department of Natural Resources at Cornell. Where the earlier posting studies had surveyed private landowners to obtain their views on problems associated with hunting access, this one was designed to obtain information from hunters.

Work was begun in February 1977. The objectives were to determine:

1. socioeconomic characteristics of hunters
2. number of days spent hunting in 1976 for several game species according to type of private or public land hunted upon
3. access problems encountered in seeking lands for hunting different species in 1976
4. additional hunter days that might be expected if more lands were available for hunting
5. amount hunters would be willing to pay as a day-use fee to a private landowner for hunting privileges
6. hunters' evaluation of FWMA cooperative hunting areas² in 1976

Information on these topics should provide useful insight on hunting in New York and help hunters, landowners and wildlife managers plan programs to improve both hunting access and hunter-landowner relations.

METHODS AND PROCEDURES

A mail questionnaire was developed and pretested on a sample of 2,000 holders of licenses to hunt residing in Dutchess and Cayuga Counties (1,000 per county). Of the deliverable questionnaires, 1,228 (64 per cent) were returned adequately completed to be coded for analysis. A follow-up survey of 100 nonrespondents was made in each county, and a 50 per cent response was attained. No substantial differences were found between the original responses and those of the follow-up survey.

After the pretest, the questionnaire was evaluated and modified for use in a statewide survey. Names and addresses of hunters were drawn

² Private lands on which hunting is permitted under provisions of the Fish and Wildlife Management Act (originally enacted as Chapter 1016 of the Laws of 1957).



Figure 1. Map of New York State showing the nine administrative regions of the Department of Environmental Conservation and the metropolitan counties (stippled) as designated in this study.

from a sample of the 1975-76 resident hunting licenses sold, including big game, small game, and combination small game and fishing licenses. The sample was stratified to give consideration to the data in terms of both the nine administrative regions of the Department of Environmental Conservation and the metropolitan and rural counties of the State (Figure 1). For each entirely metropolitan or entirely rural region, 750 licenses were drawn, the number for each county being in the same ratio to 750 as the number of licenses sold in the county was to the total number sold in the region. For regions that contained both metropolitan and rural counties, 750 licenses were drawn for the metropolitan county (or counties) and 750 were drawn proportionately for the rural counties. The two pretested counties were not resampled, the responses from them being weighted in proper proportion to those from the other counties in their region. This procedure ensured an adequate sample size for comparing metropolitan and rural areas as well as for comparing the Department's administrative regions.

The following were considered metropolitan areas: all counties in Regions 1 and 2, Albany County in Region 4, Oneida County in Region 6, Broome and Onondaga Counties in Region 7, Monroe County in Region 8 and Erie County in Region 9. All other counties

were considered rural, although many fell within a Standard Metropolitan Statistical Area as defined by the U.S. Bureau of Census (1970). Classifying the latter as rural facilitated examining the hunting activities of licensees from high-density urban areas, since any difference between metropolitan residents and rural residents would be clouded if data for surrounding SMSA counties demographically influenced by a major urban center were lumped with those for the urban center itself.

Comparison and analysis of metropolitan vs. rural areas was possible since in each case the data were derived from a sample of 750 licensees, regardless of whether the area was an entire region or a county within a region. The data were weighted to permit analyses on county, regional and statewide levels. All weightings within and between regions were based on the county of license purchase since data on those proportions were available from the Department's summaries of license sales, and the license records were organized by the area of license purchase. However, the data were analyzed by the area of residence since this was the most meaningful interpretation for management considerations. A high correlation between area of license purchase and that of residence was found; 88.1 per cent of the respondents had purchased their licenses in the county where they resided. This proportion was similar for both metropolitan and rural hunters (85.8 and 89.9, respectively).

The initial questionnaire and cover letter were mailed on February 15, 1977 and were followed by a reminder letter on February 25, 1977, a second questionnaire and cover letter on March 8, 1977 and a final reminder letter on March 16, 1977. Of the 11,016 initial questionnaires, 769 were nondeliverable. Of the 10,247 that were deliverable, 7,030 (68.6 per cent) were returned and 6,512 (63.6 per cent) were useable.

Although the names of the hunters constituting the sample were obtained from records of 1975-76 licenses sold, the questions asked pertained to their hunting activities in 1976. The data were analyzed by computer according to "The Statistical Package for the Social Sciences" (Nie et al., 1975) and the "APL Computer Language" (International Business Machines, 1976). Significance is expressed in terms of the 95 per cent level of confidence. Unless otherwise indicated, references to region mean the respondent's region of residence.

FINDINGS

Responses to the questionnaire furnished information concerning the characteristics of the hunters themselves and their activities, the problems they encountered afield and their attitude toward various means of improving hunting opportunity.

PROFILE OF RESPONDING HUNTERS

The characteristics of the hunters sampled constitute an important factor in interpreting the data concerning their hunting activities and attitudes.

AGE The mean age for all respondents was 39 years, somewhat older than the mean of 36 found for New York State hunters in a 1966 study (Bevins et al., 1968). However, the median age was 36 years, somewhat younger than that of 40 recorded for males 14 years old or over in the general population of the State in 1970 (U.S. Bureau of Census, 1970).

EDUCATION With respect to education, the mean for all respondents was 12.6 years, and the median was 12 years. The latter was the same as that reported in 1970 for males 14 years old or over in the general State population (U.S. Bureau of Census, 1970).

RESIDENCE FOR FIRST 16 YEARS OF LIFE Statewide, the majority (61 per cent) of the respondents had spent most of their first 16 years in rural areas or villages. This finding was similar to that of Bevins et al. (1968) who reported that 64 per cent of New York State hunters were from rural areas.

OCCUPATION The most prevalent occupational category among the respondents was craftsman-foreman. Nine categories each comprised at least 5 per cent of the respondents: craftsman-foreman (19.0), professional-technical (13.7), operative (10.7), student (10.3), retiree (9.8), managerial-official (6.8), clerical-sales (6.1), house-service worker (5.4) and laborer (5.2).

HUNTING PARTICIPATION

To derive estimates of the proportions of hunting activity on lands in various types of ownership in 1976, information on big game, small game and waterfowl hunting was obtained for the following: State forests and parks, wildlife management areas, other public lands (unclassified), FWMA cooperative areas, commercial shooting preserves, sportsmen's clubs and private property (other than FWMA areas, preserves and clubs). The data are presented initially as mean days of hunting. Based on these means, the data were expanded to give conservative estimates of the total amount of days hunters spent hunting on land in each type of ownership,³ and the proportions were also calculated.

FREQUENCY OF HUNTING The relative amount of time spent by

³ In the expansion procedure, it was assumed that nonrespondents were non-participants. The total number of license holders used in the expansion was based on an estimate developed by the U.S. Fish and Wildlife Service (1977).

TABLE 1. RELATIVE TIME SPENT IN HUNTING BIG GAME, SMALL GAME AND WATERFOWL, ACCORDING TO RESPONDENT'S AREA OF RESIDENCE, IN 1976

Area of residence	Time (mean days per hunter)		
	Big game	Small game	Waterfowl
Region 1*	8.2	11.8	13.9
Region 2*	8.4	13.1	4.0
Region 3	10.7	17.7	10.4
Region 4	12.8	20.1	7.3
Albany County*	12.8	19.5	7.9
Other counties	12.9	19.9	7.3
Region 5	14.8	18.7	14.1
Region 6	15.0	18.2	11.2
Oneida County*	15.0	18.1	10.4
Other counties	15.0	17.8	11.4
Region 7	11.3	18.1	10.8
Broome County*	11.3	19.0	8.4
Onondaga County*	11.5	13.5	7.3
Other counties	11.4	20.1	12.9
Region 8	9.9	17.7	8.6
Monroe County*	8.6	12.8	8.9
Other counties	10.4	19.9	8.5
Region 9	10.0	15.5	8.4
Erie County*	9.9	15.2	7.4
Other counties	10.1	15.6	9.4
Metropolitan areas	10.1§	14.8†	9.2
Rural areas	11.6§	18.7†	10.4
Total	11.0	17.2	10.0

* Metropolitan area.

§ Significantly different ($t = -6.28$; $P > 0.95$).

† Significantly different ($t = -5.77$; $P > 0.95$).

hunters from different parts of the State in hunting the three classes of game is summarized in Table 1.

Big Game Statewide, big game hunting averaged 11 days per hunter. The mean was highest for hunters from Regions 5 and 6 (about 15 days each)⁴ and lowest for those from Regions 1 and 2 (about 8 days each). Big game hunters from rural areas hunted slightly more than those from metropolitan areas (11.6 and 10.1 days, respectively) and, due to the large sample size, the difference was statistically significant.

Small Game Small game was hunted an average of 17.2 days per hunter, varying from 11.8 days for hunters from Region 1 to 20.1 days for those from Region 4. Statewide, rural residents spent significantly

⁴ A somewhat greater amount of big game hunting was expected for residents of Regions 5 and 6 since those regions are in the Northern Zone which had a longer open season than the rest of the State.

more time than metropolitan residents (18.7 and 14.8 days, respectively). Conservative expansions of these data to represent all resident hunters in New York (see Table 2) show that small game hunting, at about 5 million hunter days, ranked first in time spent, while big game hunting was second and waterfowl hunting had the least amount of participation.

Waterfowl Waterfowl hunting averaged 10 days per hunter, varying from about 14 days for hunters from Regions 1 and 5 to 4 days for those from Region 2. Statewide, there was no significant difference between metropolitan and rural hunters (9.2 and 10.4 days, respectively).

RELATIVE IMPORTANCE OF LAND OWNERSHIP TYPES Land in private ownership provided more days of hunting than did public lands for the study respondents (Table 2), and private property (other than FWMA areas, commercial shooting preserves and sportsmen's clubs) was hunted upon most frequently. This was true for both metropolitan and rural respondents with respect to big game and small game hunting, and for rural respondents with respect to waterfowl hunting. However, metropolitan respondents used public lands slightly more than private property for waterfowl hunting. This was the only marked difference at the state level between metropolitan and rural hunters in their use of lands in different types of ownership. The relative use of the ownership types is shown in Figure 2 for the three classes of game. In the discussion of this topic, percentages represent days of hunting.

Big Game Statewide, 62 per cent of all big game hunting was done on private lands, the vast majority (91 per cent) on private prop-

TABLE 2. ESTIMATED NUMBER OF DAYS OF HUNTING FOR BIG GAME, SMALL GAME AND WATERFOWL ON LANDS IN DIFFERENT TYPES OF OWNERSHIP*

Type of ownership	Number of days (in thousands)§		
	Big game	Small game	Waterfowl
State forest and parks	859.5 ± 50.7	520.3 ± 52.9	68.2 ± 17.5
Wildlife management areas	170.0 ± 24.3	182.9 ± 31.7	78.1 ± 16.3
'Other' public land	533.4 ± 42.1	911.1 ± 83.6	210.1 ± 35.3
FWMA cooperative areas	45.8 ± 9.9	90.1 ± 21.1	12.6 ± 6.0
Commercial shooting preserves	9.1 ± 4.9	38.7 ± 13.2	9.0 ± 5.0
Private property	2,335.6 ± 72.3	2,990.3 ± 132.9	342.1 ± 35.2
Sportsmen's clubs	210.3 ± 26.5	217.4 ± 37.5	20.2 ± 6.7
Total†	4,150.4 ± 89.1	5,065.4 ± 199.5	766.3 ± 67.1

* Estimates are conservative because expansion procedure treated nonrespondents as nonparticipants.

§ Expansions at $P > 0.95$.

† Totals do not equal the exact sums of the figures for the several types of ownership due to rounding and because some respondents gave only total days without figures for the different types.

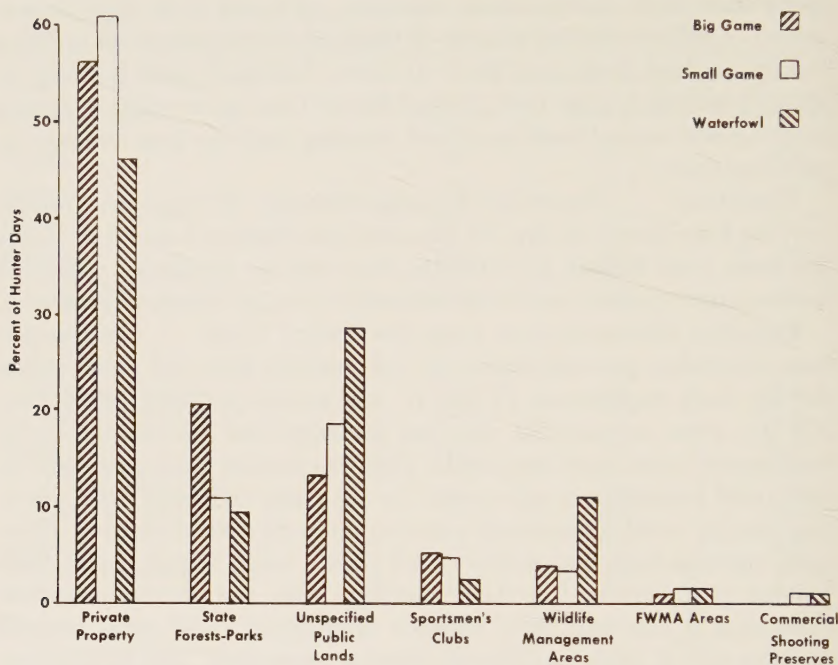


Figure 2. Relative use of land ownership types for big game, small game and waterfowl hunting.

erty other than FWMA areas, shooting preserves or sportsmen's clubs. Most big game hunting on public lands was on State forests and parks; very little was done on wildlife management areas. There was little difference between hunters from metropolitan areas and those from rural areas in their use of lands under different types of ownership.

Only hunters from Regions 5 and 6 (which include the Adirondack Forest Preserve) reported that less than 50 per cent of their big game hunting was done on private lands. Private property alone provided from 53 to 72 per cent of such hunting for respondents from other regions. FWMA areas, shooting preserves and sportsmen's clubs combined provided only a small proportion, chiefly (15 per cent) in Region 3.

State forests and parks were most important for big game hunters from Regions 5 and 6 (37 and 34 per cent, respectively) and least important for those from Regions 3, 4, 8 and 9 (less than 20 per cent each). For hunters from Regions 1, 2 and 7, the proportions were between 22 and 24 per cent. Use of wildlife management areas for big game hunting varied between 3 and 5 per cent in different regions. Use of other public lands was greater, ranging from 7 per cent for hunters from Regions 1 and 2 to 18 per cent for those from Region 5.

Sportsmen's clubs provided 5 per cent of the big game hunting statewide, about the same proportion as FWMA areas, wildlife management areas and shooting preserves combined. The contribution of such clubs was greatest (13 per cent) for hunters from Region 3.

Small Game About two-thirds of the small game hunting was done on privately owned lands, the vast majority (90 per cent) on private property other than FWMA areas, shooting preserves or sportsmen's clubs. The proportions for metropolitan and rural hunters were very similar for the State as a whole, while the variation among regions ranged from 45 per cent for hunters from Region 5 to 69 per cent for those from Region 8.

Public lands other than State forests and parks and wildlife management areas were generally second in importance for small game hunting, supplying 18 per cent statewide. The proportion ranged between 10 per cent for hunters from Region 2 and 23 per cent for those from Regions 5 and 6. There was little difference between metropolitan and rural hunters in their use of these lands. Use of State forests and parks varied considerably between regions, largely reflecting their locations, and ranged from 4 per cent for hunters from Region 8 to 28 per cent for those from Region 5, with a statewide average of 10 per cent. Wildlife management areas, FWMA areas, shooting preserves and sportsmen's clubs were used relatively little.

Waterfowl Lands in public and private ownership supplied similar proportions (48 and 52 per cent, respectively) of waterfowl hunting statewide. Metropolitan respondents tended to use public lands (especially "other" public lands) to a greater degree than did rural respondents. The latter used private property for the majority of their waterfowl hunting.

Private property was the most important type, accounting for 46 per cent of waterfowl hunting statewide. However, it was not the most important in all regions; hunters from Regions 1 and 2 reported that public lands other than State forests and parks or wildlife management areas were used to a greater degree. The proportion of waterfowl hunting on private property varied from 18 and 20 per cent, respectively, for hunters from Regions 1 and 2 to 57 per cent for those from Region 8. Relative use by metropolitan and rural hunters differed considerably, i.e., 35 to 51 per cent, respectively.

Public lands other than State forests and parks and wildlife management areas generally received the second greatest amount of use (28 per cent) for waterfowl hunting. However, as already noted, these unclassified public lands were more important than any other type for waterfowl hunters from Regions 1 and 2. Wildlife management areas provided 11 per cent of the waterfowl hunting statewide, with little

difference in relative use by metropolitan and rural hunters. These areas were most important to hunters from Region 6, for whom they provided 20 per cent of their waterfowl hunting, and least important to hunters from Region 3 (1 per cent). State forests and parks provided a proportion (9 per cent) of waterfowl hunting statewide similar to that of wildlife management areas. They were most important to respondents from Regions 5 and 9, for whom they provided 19 and 18 per cent, respectively, of their waterfowl hunting, and least important to respondents from Region 8 (3 per cent). Sportsmen's clubs, FWMA areas and shooting preserves provided relatively little waterfowl hunting.

PREFERRED TYPES OF HUNTING LAND The types of land respondents hunted on may reflect the relative supply of such lands rather than the actual preferences of the hunters. Consequently, hunters in the survey were asked to indicate whether they liked, disliked or had no preference for the various types of public and private lands, if all were equally available for hunting.

Mean preference values were computed for the seven ownership types considered. To obtain these, the response options were given the following values: strongly like—1; like—2; no preference (neutral)—3; dislike—4; strongly dislike—5. Thus, the lower the mean for a type, the more it was liked by the hunters. A statistical procedure called Duncan's multiple range test (Duncan, 1955; Nie et al, 1975) was employed to rank the ownership types from most to least preferred. Means that differed significantly were given different ranks, which are depicted for metropolitan and rural hunters as well as for the total sample in Figure 3.

Private property was the most preferred for hunting. For the State as a whole, State forests and parks and "other" public lands were on a secondary level and were closely followed by wildlife management areas which were ranked third. FWMA areas were on a fourth level, while sportsmen's clubs were fifth. Commercial shooting preserves were generally disliked by the hunters surveyed. The mean values given by metropolitan hunters and rural hunters were very similar with respect to private property, State forests and parks, other public lands and shooting preserves, and they differed only slightly with respect to wildlife management areas, FWMA areas and sportsmen's clubs.

Hunters were asked what ownership type they most liked to hunt on, and private property was chosen by 60 per cent. Second was State forests and parks; however, this was preferred by far fewer hunters (16 per cent) than private property. Each of the other types was chosen by less than 6 per cent of the respondents. Responses were similar for metropolitan and rural hunters.

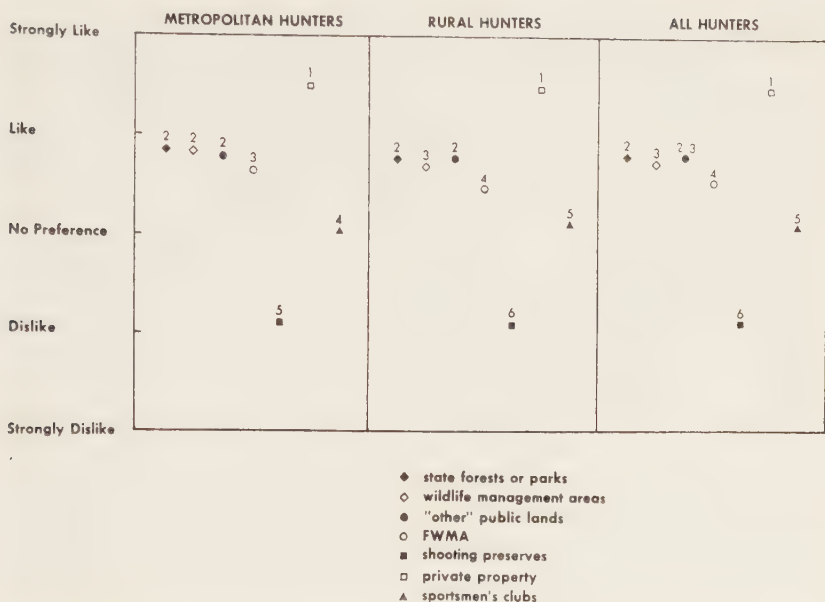


Figure 3. Relative rank, as determined by Duncan's multiple range test (Duncan, 1955), of mean values for preference by metropolitan hunters, rural hunters and all hunters for lands in different ownership types. Numeral above symbol represents rank; in each case means that did not differ significantly have the same rank.

HUNTING ACCESS PROBLEMS

Problems associated with access to favorable hunting territory include several aspects besides restrictions due to posting. The degree to which these problems affect hunters who do not own or have ready access to hunting lands was a primary concern in this study.

KNOWLEDGE OF DESTINATION IN ADVANCE OF HUNTING TRIP An important factor in evaluating access problems is the extent to which hunters go afield without prior knowledge of whose land they will hunt on. More hunters with unknown destinations than those who had a specific place where they knew they had permission to hunt encountered access problems, 69 and 42 per cent, respectively. Statewide, for about 16 per cent of big game hunting, 21 per cent of small game hunting and 18 per cent of waterfowl hunting, respondents did not know in advance whose land they would be hunting on. These figures include some hunters who knew the prospective location but did not know who owned the land.

ACCESS PROBLEMS Access problems were encountered by 52 per cent of the respondents when seeking lands for hunting. About 15 per cent indicated that they had experienced only posting problems, 19 per cent reported that they had other access problems (e.g., parking,

crowding, road access) but not posting problems, and 18 per cent had both posting and other access problems. Based on these proportions, it is estimated that about 226,000 hunters encountered some type of land access problem while afield in 1976. About 143,000 encountered posting problems, about 164,000 experienced access problems other than posting, and about 78,000 had both posting and other access problems.

The regional variation in the proportion of hunters who encountered access problems was narrow. Region 2 had the lowest and Region 3 the highest proportion (48 and 57 per cent, respectively). Statewide, the proportion was significantly greater for hunters from metropolitan areas than for those from rural areas.

Considering all types of access problems in relation to socioeconomic variables, the proportion was greater for younger hunters than for older hunters. Of those 25 years old or less, 59 per cent reported an access problem, compared with only 33 per cent of those over 65. The incidence was somewhat lower for hunters with a rural childhood background than for those who had spent most of their first 16 years in villages or cities (Table 3).

TABLE 3. PROPORTIONS WHO DID AND WHO DID NOT ENCOUNTER LAND ACCESS PROBLEMS FOR RESPONDENTS IN DIFFERENT SOCIOECONOMIC GROUPS

Group	Proportion (per cent)*	
	Encountered problem	Did not encounter problem
Age (years)		
1-25	59.3 (846)	40.7 (580)
26-45	55.3 (1,544)	44.7 (1,245)
46-65	43.2 (670)	56.8 (882)
66 or over	33.3 (129)	66.7 (259)
Residence area during first 16 years		
Rural	47.3 (1,186)	52.7 (1,322)
Village	52.1 (703)	47.9 (647)
Small city	58.5 (554)	41.5 (393)
Medium city	59.7 (350)	40.3 (236)
Large city	53.5 (486)	46.5 (423)
Educational attainment (years)		
1- 8	38.7 (141)	61.3 (224)
9-11	50.2 (533)	49.8 (529)
12	51.5 (1,309)	48.5 (1,234)
13-15	58.0 (799)	42.0 (578)
16 or more	53.0 (480)	47.0 (426)

* Figures in parentheses represent number of respondents in each case.

The data in Table 3 indicate a positive correlation between education and the proportion of hunters reporting access problems. This can be explained by the association between education and (1) age and (2) childhood residence. Older hunters and those from rural areas, i.e., those who had fewer problems with access, had somewhat lower levels of education on the average than their younger, more urban-oriented counterparts.

ACCESS PROBLEMS OTHER THAN POSTING Although posting was reported most frequently, other access problems were encountered by about 37 per cent of the responding hunters. Collectively, these affected slightly more hunters than did posting. Statewide, they affected only slightly more metropolitan than rural hunters (Table 4), but the difference was statistically significant. Among the regions, the propor-

TABLE 4. PROPORTION OF RESPONDENTS WHO ENCOUNTERED PROBLEMS OTHER THAN POSTING

Area of residence	Total (per cent)	According to problem (per cent)				
		Crowding	Informa- tion	Parking	Road access	Other
Region 1*	45.9	64.0	51.1	23.1	19.9	20.4
Region 2*	38.6	55.1	63.6	22.9	20.3	17.8
Region 3	42.6	61.5	40.6	27.8	20.3	24.1
Region 4	38.5	70.0	26.7	19.3	16.0	28.7
Albany County*	41.6	67.3	36.4	28.2	16.4	22.7
Other counties	38.6	71.5	23.7	18.3	18.3	29.8
Region 5	35.1	64.2	31.3	18.7	25.4	28.2
Region 6	36.9	63.0	26.5	23.5	25.3	24.1
Oneida County*	43.6	60.6	26.6	27.1	26.1	20.2
Other counties	32.3	64.8	27.0	21.1	24.1	27.0
Region 7	35.6	63.2	26.3	20.5	16.4	29.2
Broome County*	38.1	57.4	30.2	19.1	16.0	32.5
Onondaga County*	37.6	68.6	30.7	26.8	20.3	20.1
Other counties	35.4	61.7	25.5	18.9	14.3	32.1
Region 8	34.9	73.4	27.8	12.7	15.8	25.3
Monroe County*	36.1	66.2	33.1	19.6	13.5	14.2
Other counties	34.9	76.3	26.6	9.2	16.2	31.8
Region 9	33.7	54.8	33.6	15.4	18.1	30.2
Erie County*	37.0	59.9	42.0	16.7	9.8	24.8
Other counties	30.9	56.4	25.2	14.2	15.6	37.0
Metropolitan areas	39.6§	62.4	40.9†	21.2	18.9	21.3‡
Rural areas	35.8§	65.3	28.8†	18.1	18.0	29.8‡
Total	37.3	64.2	33.6	19.2	18.4	26.3

* Metropolitan area.

§ Significantly different ($\chi^2 = 8.708$, 1 d.f.; $P > 0.95$).

† Significantly different ($\chi^2 = 36.926$, 1 d.f.; $P > 0.95$).

‡ Significantly different ($\chi^2 = 20.718$, 1 d.f.; $P > 0.95$).

tions varied from 34 per cent for Region 9 to 46 per cent for Region 1. In each region having both metropolitan and rural counties, a greater proportion of metropolitan hunters experienced problems.

For hunters with nonposting access problems, crowding was reported most frequently and ranged from 55 per cent for Region 2 to 73 per cent for Region 8. Statewide, the proportions for metropolitan and rural hunters did not differ significantly.

Insufficient information on hunting areas ranked second to crowding and was listed statewide by about 34 per cent of the hunters who reported problems other than posting, being most acute in Regions 1 and 2. The proportion was significantly greater for metropolitan than rural hunters.

Parking problems were encountered by relatively few respondents (19 per cent of those with problems other than posting) and had their highest incidence (28 per cent) among hunters from Region 3. Statewide, the incidence was similar for both metropolitan and rural hunters.

Road access was a problem for about 18 per cent of the respondents who reported problems other than posting. There was little variation between regions, or between metropolitan and rural hunters either within regions or statewide.

The socioeconomic characteristics of hunters who reported problems other than posting closely paralleled those of hunters who reported posting problems. Hunters who were 25 years old or less experienced the highest incidence (44 per cent). Incidence was nearly 40 per cent for those 26 to 45 years old, about 30 per cent for those 46 to 65 years old and only 23 per cent for hunters over 65 years old. Hunters who had spent most of the first 16 years of their lives in rural areas had the lowest incidence (33 per cent), while for those who spent most of their first 16 years in villages or cities it was 37 to 43 per cent. About 30 per cent of hunters with only a grade school education reported problems other than posting, while the proportion was 36 to 42 per cent for those with more education.

POSTING PROBLEMS Posting, the most frequent access problem confronting hunters, was investigated by determining the proportion for whom posted land posed some difficulty in finding a place to hunt. About one-third of the respondents reported this problem, with the variation among regions being relatively narrow, ranging from 28 to 36 per cent (Table 5). Statewide, the proportion was only slightly, but significantly, greater for metropolitan than rural hunters.

As was true for all access problems, age, residence background and education of the hunters were related to the proportion who reported posting as a problem. Of those 45 years old or less, 36 per cent had

TABLE 5. PROPORTION OF RESPONDENTS WHO ENCOUNTERED LAND ACCESS PROBLEMS DUE TO POSTING

Area of residence	Proportion (per cent)
Region 1*	27.7
Region 2*	28.4
Region 3	34.3
Region 4	28.1
Albany County*	38.9
Other counties	26.9
Region 5	31.9
Region 6	32.0
Oneida County*	38.6
Other counties	28.2
Region 7	31.8
Broome County*	29.4
Onondaga County*	34.0
Other counties	33.4
Region 8	36.4
Monroe County*	38.0
Other counties	36.0
Region 9	32.6
Erie County*	39.7
Other counties	26.4
Metropolitan areas	34.2§
Rural areas	31.2§
Total	32.4

* Metropolitan area.

§ Significantly different ($\chi^2 = 5.944$, 1 d.f.; $P > 0.95$).

such problems, compared with about 26 per cent for those 46 to 65 years old and only 17 per cent for those over 65.

The population characteristics of the area where respondents spent most of the first 16 years of their lives had only a slight relationship to their probability of encountering posting problems. As a group, hunters who had spent most of these years in rural areas reported the lowest incidence (28 per cent) compared with 33 to 40 per cent for those from villages or cities.

Compared with hunters in other education categories, 19 per cent of those who had only finished grade school reported posting problems, while the proportion was about 29 per cent for respondents with some high school education and 32 per cent for high school graduates. It was highest among hunters with some college education and those with four years or more of college (38 and 36 per cent, respectively). Again, the proportion was lower for the older, rural hunters who tended to have had less education than it was for those with higher

levels of education and who were generally younger and more urban oriented.

POSTING PROBLEMS ACCORDING TO SPECIES HUNTED⁵ Posting problems were investigated for 11 game species (or types). Responding hunters were stratified by their county of residence, i.e., metropolitan or rural. The proportion who encountered a posting problem while hunting in a particular county, rather than the number of times a person hunted or met with posting restrictions, was used as an indicator of the magnitude of such problems. Hunters were simply asked to list the counties where they hunted for particular species and to indicate in which of them posting made it difficult to find a suitable place to hunt. For each species, the median of these proportions for the counties in which it was reported to have been hunted was calculated for all hunters as well as for metropolitan and rural hunters. The median values were used as a measure of the relative rank of posting with respect to the different species in terms of all hunters and to compare its importance for metropolitan vs. rural hunters (Table 6).

TABLE 6. MEDIAN PROPORTION OF RESPONDENTS WHO ENCOUNTERED POSTING PROBLEMS ACCORDING TO SPECIES OR TYPE OF GAME, FOR COUNTIES HAVING ADEQUATE SAMPLES

Species or type of game	Proportion (per cent)*		
	All hunters	Metropolitan hunters	Rural hunters
Ring-necked pheasant	23.5 (44)	21.0 (42)	21.0 (44)
Big game	19.0 (53)	18.0 (53)	18.0 (53)
Waterfowl	19.0 (19)	18.5 (18)	17.0 (19)
Woodcock	18.0 (15)	19.5 (14)	16.0 (15)
Cottontail rabbit and snowshoe hare	13.5 (52)	16.0 (50)	13.0 (52)
Squirrels	13.0 (42)	14.0 (41)	12.5 (42)
Wild Turkey	13.0 (7)	12.0 (7)	13.0 (7)
Ruffed grouse	11.0 (37)	13.5 (36)	12.0 (37)
Quail§	32.3 (1)	31.4 (1)	†

* Figures in parentheses represent number of counties in each case.

§ Quail could be hunted legally in only one county.

† Only one rural respondent hunted quail in the county, and he reported a posting problem.

Only counties in which at least 30 respondents (metropolitan plus rural) reported hunting for a particular species or type of game were included in the analyses because the probability of unacceptable sampling errors was considered high in samples of less than 30. For counties meeting this requirement, data for metropolitan or rural hunters are presented if at least 10 observations were obtained.

⁵ Under this topic, references to county, unless otherwise specified, mean county hunted in, not county of residence.

The ring-necked pheasant was the species for which responding hunters most frequently encountered posting problems. Big game, waterfowl and woodcock ranked at a second level; cottontail rabbit/snowshoe hare, squirrels and wild turkey ranked third; and the ruffed grouse was last. The order differed somewhat when hunters from metropolitan and rural counties were considered separately; however, the differences were not striking, cottontail rabbit/snowshoe hare being the only species for which the difference exceeded 1.5 per cent.

To evaluate posting problems in relation to the species being hunted, the counties where more than 20 per cent of the respondents reported such problems with respect to a given species were grouped separately (Table 7). Twenty per cent was used as a minimum be-

TABLE 7. FOR EACH SPECIES, RELATIVE RANK OF COUNTIES FOR WHICH SAMPLE WAS ADEQUATE AND MORE THAN 20 PER CENT OF ALL RESPONDENTS REPORTED POSTING PROBLEMS

Species*	County and percentage of respondents who reported posting problems					
Ring-necked pheasant	Erie	(39.6)	Chautauqua	(30.5)	Orleans	(26.3)
	Chemung	(38.8)	Genesee	(30.1)	Putnam	(25.4)
	Monroe	(38.8)	Wayne	(29.2)	Columbia	(25.3)
	Suffolk	(38.2)	Schenectady	(29.0)	Livingston	(25.2)
	Seneca	(37.5)	Tompkins	(28.2)	Cortland	(23.9)
	Niagara	(36.2)	Onondaga	(28.0)	Steuben	(23.8)
	Montgomery	(32.4)	Dutchess	(26.9)	Schuyler	(22.9)
	Ontario	(30.8)	Washington	(26.7)	Albany	(20.7)
Big game	Westchester	(62.9)	Columbia	(24.9)	Otsego	(21.8)
	Monroe	(34.0)	Orleans	(24.6)	Onondaga	(21.7)
	Washington	(32.6)	Tioga	(24.3)	Chenango	(21.5)
	Ontario	(31.1)	Erie	(23.2)	Albany	(21.4)
	Tompkins	(28.5)	Seneca	(23.2)	Orange	(21.0)
	Chemung	(27.1)	Schoharie	(22.7)	Schuyler	(20.9)
	Dutchess	(25.8)	Yates	(22.6)	Clinton	(20.5)
	Livingston	(25.4)	Steuben	(22.4)		
Cottontail rabbit and snowshoe hare	Dutchess	(30.8)	Erie	(26.2)	Schenectady	(22.5)
	Monroe	(30.2)	Ontario	(25.4)	Niagara	(21.4)
	Suffolk	(27.9)	Tompkins	(25.0)	Onondaga	(20.7)
	Cortland	(27.3)	Genesee	(23.6)		
Waterfowl	Orleans	(33.3)	Nassau	(26.7)	Genesee	(23.2)
	Seneca	(30.2)	Monroe	(24.0)	Wayne	(23.1)
	Niagara	(27.1)	Cayuga	(23.3)	Suffolk	(21.0)
Ruffed grouse	Onondaga	(28.2)	Chemung	(22.5)	Orange	(20.5)
	Putnam	(27.3)	Dutchess	(21.1)	Greene	(20.4)
Squirrels	Monroe	(24.4)	Wayne	(22.2)	Suffolk	(21.9)
	Erie	(22.4)	Schenectady	(21.9)	Niagara	(21.5)
Woodcock	Suffolk	(35.0)	Erie	(27.1)		
	Chemung	(27.3)	Niagara	(23.5)		
Other	Monroe	(26.7)	Erie	(21.9)		
Quail	Suffolk	(32.2)				

* For no county did over 20 per cent of the respondents report posting problems with respect to hunting wild turkey.

cause: (1) it was near the average proportion of hunters who reported posting problems in all counties for given species; (2) it was assumed that in many areas of the State it would not be realistic to expect a hunting access program to improve access to the point that less than one out of five hunters would regard posting as a problem; and (3) those counties where more than 20 per cent of the respondents reported posting problems probably represented areas of primary access concern at the time.

Metropolitan and rural hunters were compared where large differences occurred, even if the over-all county level of posting problems was 20 per cent or less. Only counties where the difference was 10 per cent or more are noted. Counties for which there were fewer than 10 observations for either hunter group were omitted because of insufficient data.

Ring-necked Pheasant The frequency of reported posting problems exceeded 20 per cent in over half of the 44 counties where 30 or more respondents hunted pheasant. It ranged up to nearly 40 per cent and was most severe in Erie, Chemung, Monroe and Suffolk Counties. Substantially more metropolitan than rural hunters encountered such problems in Tompkins (50 vs. 23 per cent), Niagara (48 vs. 30 per cent), Monroe (42 vs. 22 per cent), Genesee (41 vs. 25 per cent) and Columbia (35 vs. 18 per cent) Counties, while the reverse was true in Onondaga (25 vs. 50 per cent) and Wayne (20 vs. 34 per cent) Counties.

The posting problems of metropolitan and rural hunters sometimes differed considerably in counties where 20 per cent or fewer pheasant hunters reported such problems. The frequency was greater for metropolitan hunters in Orange (33 vs. 16 per cent), Rensselaer (27 vs. 7 per cent) and Madison (21 vs. 6 per cent) Counties, but less in Wyoming County (9 vs. 21 per cent).

Big Game In 23 of the 53 counties for which there was an adequate sample of big game hunters, over 20 per cent of the respondents reported posting problems. Westchester County was the extreme, with about two out of three respondents who hunted big game there reporting problems. Monroe County was next (34 per cent), considerably below Westchester. Posting problems were notably greater for rural respondents than for metropolitan respondents who hunted in Monroe (44 vs. 32 per cent), Dutchess (31 vs. 16 per cent), Schoharie (28 vs. 12 per cent) and Schuyler (25 vs. 6 per cent) Counties. In Westchester County, problems were greater for metropolitan hunters (100 vs. 46 per cent).

There were notable differences between metropolitan and rural big game hunters in several counties where 20 per cent or fewer respon-

dents reported posting problems. More problems were encountered by metropolitan hunters in Cayuga (31 vs. 6 per cent), Rensselaer (31 vs. 16 per cent), Chautauqua (26 vs. 15 per cent) and Greene (22 vs. 10 per cent) Counties.

Waterfowl In nearly half of the 19 counties where at least 30 respondents hunted waterfowl, over 20 per cent reported posting problems. The highest incidence, about one-third, was in Orleans and Seneca Counties. Metropolitan and rural hunters differed in several of the nine counties, but sample sizes were adequate for valid comparison in only four. The incidence was greater for metropolitan hunters in Orleans (50 vs. 26 per cent), Niagara (39 vs. 20 per cent) and Cayuga (29 vs. 16 per cent) Counties, while the reverse was true for Genesee County (15 vs. 28 per cent).

For counties where 20 per cent or fewer waterfowl hunters reported posting problems, Madison was noteworthy in that the incidence for metropolitan hunters was 36 per cent.

Woodcock In only four of the 15 counties where an adequate sample of woodcock hunters was obtained did over 20 per cent of the respondents report posting problems. The incidence was greatest, over one-third, in Suffolk County. Metropolitan and rural hunters were not compared for these four counties because the data were insufficient for this purpose.

Where 20 per cent or fewer of the respondents reported posting problems, the incidence was considerably greater for metropolitan than rural hunters in Orange County (30 vs. 7 per cent), while rural hunters encountered notably more problems in Cattaraugus (24 vs. 10 per cent) and Allegany (23 vs. 0 per cent) Counties.

Cottontail Rabbit and Snowshoe Hare Of the 52 counties for which the sample was adequate, there were 11 where over 20 per cent of the respondents who hunted cottontail rabbits or snowshoe hares encountered posting problems. The incidence was highest in Dutchess and Monroe Counties (31 and 30 per cent, respectively). The proportions for metropolitan and rural hunters differed in several of the 11 counties, but small numbers of respondents made valid comparison difficult in many cases. Metropolitan hunters encountered somewhat more problems than did rural hunters in Niagara (42 vs. 17 per cent), Genesee (33 vs. 19 per cent) and Erie (27 vs. 10 per cent) Counties.

The posting problems of metropolitan and rural hunters differed considerably in several counties where 20 per cent or fewer of the respondents reported such problems. The incidence was greater for metropolitan hunters in Ulster (47 vs. 12 per cent), Livingston (31 vs. 16 per cent), Orange (30 vs. 15 per cent), Tioga (29 vs. 13 per cent), Putnam (25 vs. 13 per cent) and Greene (23 vs. 4 per cent) Counties. It was greater for rural hunters in Broome (29 vs. 17 per cent) County.

TABLE 8. COUNTIES FOR WHICH MORE THAN 20 PER CENT OF ALL RESPONDENTS REPORTED POSTING PROBLEMS IN HUNTING FOR AT LEAST ONE SPECIES, ACCORDING TO WHETHER THE PROBLEM PERTAINED TO ALL, METROPOLITAN OR RURAL HUNTERS*§

County	Species†							
	Pheasant	Big game	Cottontail/ snowshoe	Waterfowl	Ruffed grouse	Squirrels	Woodcock	Other
Albany	A M	A M	..	..	..	R	..	..
Allegany	..	..	..	..	..	..	R	..
Broome	..	..	R	..	..	R	..	..
Cattaraugus	..	..	..	..	..	..	R	M
Cayuga	..	M	..	A M	..	..	..	..
Chautauqua	A R	M	..	..	..	..	..	..
Chemung	A R	A R	..	..	A R	..	A R	..
Chenango	R	A R	..	..	..	..	M	..
Clinton	..	A R	..	..	..	..	..	..
Columbia	A M	A M R	..	..	M	M	..	..
Cortland	A R	R	A .. R	..	..	..	..	..
Delaware	..	R	..	..	..	..	..	R
Dutchess	A M R	A R	A M R	..	A R	..	M	..
Erie	A M R	A M	A M	..	..	A M	A M	A M
Genesee	A M R	..	A M	A R	..	..	..	..
Greene	..	M	M	..	A M	..	..	..
Livingston	A M R	A M R	M	..	M	M	..	..
Madison	M	M	..	M	..	..	..	..
Monroe	A M R	A M R	A M R	A M	..	A M	..	..
Montgomery	A R	..	..	..	..	..	..	A
Nassau	..	..	..	A M	..	..	..	..
Niagara	A M R	..	A M	A M	..	A R	A	..
Onondaga	A M R	A M R	A M	..	..	..	..	..
Ontario	A M R	A M R	A M R	..	A M	..	..	R

Orange	M A M R	A M R	M	.. A M R	A M	M	..
Orleans	A M R	A R	..	..	..	..	..
Oswego	..	M	..	..	..	..	..
Otsego	..	A R	..	..	..	..	..
Putnam	A R	..	M	..	A M R	..	..
Rensselaer	M	M	..	..	..	..	..
Schenectady	A R	..	A	..	A	..	..
Schoharie	..	A R	..	..	..	..	..
Schuyler	A R	A R	..	..	..	..	..
Seneca	A R	A R	..	A R	..	..	..
Steuben	A R	A M R	M	..	..	..	..
Suffolk	A M	..	A M	A M	A M	A M	A M
Sullivan	..	..	..	..	..	..	..
Tioga	..	A M R	M	..	M	..	..
Tompkins	A M R	A M R	A	..	..	..	..
Ulster	..	..	M	..	M	..	..
Washington	A R	A R	..	..	..	..	..
Wayne	A M R	..	..	A M R	A	R	..
Westchester	..	A M R	..	..	..	..	..
Wyoming	R	..	..	..	..	..	..
Yates	..	A M R	..	..	..	..	..
Total	24	23	11	9	6	4	1
All	17	19	15	8	8	6	1
Metropolitan	23	23	5	4	3	5	0
Rural							

* Hunter designation: A—all; M—metropolitan; R—rural.

§ County noted for a given species only if there were at least 30 reports for all hunters or 10 reports for either metropolitan or rural hunters.

[†] For no county did over 20 per cent of the respondents report posting problems with respect to hunting wild turkey.

Squirrels In only six of the 42 counties where 30 or more of the respondents hunted squirrels did over 20 per cent report posting problems. The proportion was greatest in Monroe County (24 per cent). Wayne County was the only one where there was a notable difference between metropolitan and rural hunters, with rural hunters indicating the most problems (28 vs. 9 per cent).

Where 20 per cent or fewer of the respondents reported posting problems, the incidence was greater for metropolitan hunters than rural hunters in Orange (42 vs. 15 per cent), Livingston (36 vs. 12 per cent) and Columbia (28 vs. 8 per cent) Counties, while the reverse was reported for Broome County (10 vs. 33 per cent).

Wild Turkey An adequate sample of turkey hunters was obtained for only seven counties, but in none did over 20 per cent of the respondents report posting problems. The problems reported by metropolitan and rural hunters were very similar.

Ruffed Grouse In only six of the 37 counties where an adequate sample for grouse hunters was obtained did over 20 per cent of the respondents report posting problems. The incidence was greatest in Onondaga County (28 per cent). Substantially more problems were experienced by metropolitan than rural hunters in Orange County (42 vs. 17 per cent), while the reverse was the case in Dutchess County (12 vs. 25 per cent).

Where 20 per cent or fewer of the respondents reported posting problems, the incidence was greater for metropolitan than rural hunters in Ulster (36 vs. 5 per cent), Livingston (29 vs. 10 per cent), Tioga (25 vs. 12 per cent) and Columbia (25 vs. 15 per cent) Counties.

Quail Of the respondents who hunted quail in Suffolk County, 32 per cent encountered a posting problem. Although quail were legal game only in Region 1 (unless hunted on a private preserve), quail hunting was reported for nearly every county of the State. The reasons are not known. It can only be hypothesized that: (1) respondents didn't know that the "quail" they were hunting were really grouse, woodcock or pheasant; (2) respondents were inaccurate in answering that particular item on the questionnaire; or (3) many respondents hunted quail on private preserves.

Other Game Under this heading would be included the raccoon, bobcat, coyote, red fox, gray fox, European hare and crow. There were 30 or more reports of hunting "other" game for 20 counties, but only in Monroe and Erie Counties did over 20 per cent of the respondents note posting problems.

General Incidence As illustrated in Table 8, there were only seven counties in which more than 20 per cent of the respondents reported posting problems with respect to four or more species: Suffolk,

Monroe, Erie, Niagara, Dutchess, Onondaga and Chemung. While posting in these counties was widespread, metropolitan and rural hunters often encountered very different problems there as well as in other counties. Metropolitan hunters encountered notable (i.e., cited by more than 20 per cent of the respondents) problems for four or more species in seven counties, four of which were among the seven already mentioned. Rural hunters encountered such problems in only three counties and, while the latter differed from those for metropolitan hunters, two were among the seven listed for all hunters. With respect to the five most popular species (i.e., those hunted by 30 or more respondents in the greatest number of counties), the number of counties in which notable problems were encountered differed for metropolitan and rural hunters: big game (19 vs. 23); cottontail rabbit and snowshoe hare (15 vs. 5); pheasant (17 vs. 23); squirrels (6 vs. 5); ruffed grouse (8 vs. 3), respectively (Table 8). However, for these species collectively, the figures were 65 vs. 57. These data and the values given in Table 6 indicate that, over-all, metropolitan and rural hunters were encountering similar levels of posting problems. Nevertheless, in particular counties and for particular species, the problems may be quite different.

BEHAVIOR OF HUNTERS UPON ENCOUNTERING POSTED LAND Many landowners post their property to control hunting, not to exclude all hunters (Brown and Thompson, 1976). Knowing this, it is useful to have an idea of how hunters behave upon encountering posted land. The majority of those surveyed (55 per cent) indicated that, upon encountering posted land seemingly ideal for hunting the game they sought, they would ask the landowner for permission to hunt. An additional 22 per cent stated that because they already had places to hunt the question did not apply to them. Most of the others would drive on without attempting to hunt on the posted land. Very few (1 per cent) indicated that they would hunt on posted land without permission.

Disregarding hunters for whom the question was not applicable, 71 per cent reported that upon finding favorable cover that was posted they would nevertheless stop and ask the landowner for permission to hunt. About 27 per cent indicated they would drive on, while less than 2 per cent would hunt anyway (i.e., without obtaining permission). Statewide, the responses of metropolitan and rural hunters differed significantly, with metropolitan hunters being more inclined to drive on rather than ask the landowner for permission to hunt.

While there was little difference between age groups in their reactions upon encountering posted land, this behavior did seem to vary in relation to either the size of the community where hunters had spent their first 16 years or their educational attainment. Hunters with

rural or village backgrounds were somewhat more inclined to stop and ask the owner of posted land for permission to hunt than were those who grew up in cities. A slight but consistent trend was apparent in the relationship between educational attainment and willingness to ask permission. As education increased, the proportion of hunters who indicated they would stop and ask permission decreased. The proportions ranged from about 80 per cent for those with only a grade school education to 64 per cent for those who had four years of college or more.

LATENT HUNTING DEMAND FROM ACTIVE HUNTERS

Wildlife managers charged with developing land-access programs to provide more hunting opportunity must consider not only the number of existing and potential hunters, but also the degree to which

TABLE 9. PROPORTION OF THE RESPONDENTS IN THE DIFFERENT REGIONS WHO WOULD HUNT MORE IF MORE LAND WERE AVAILABLE AND POTENTIAL INCREASE IN HUNTER DAYS FOR BIG GAME, SMALL GAME AND WATERFOWL

Area of residence	Proportion (per cent)	Potential increase in hunter days (per cent)		
		Big game	Small game	Waterfowl
Region 1*	77.3	53.9	105.1	84.2
Region 2*	75.5	53.2	89.0	310.1
Region 3	73.1	36.2	65.3	104.3
Region 4	58.8	33.1	52.7	141.0
Albany County*	69.3	46.1	67.2	169.8
Other counties	58.8	31.6	48.5	137.9
Region 5	57.2	31.5	45.6	75.1
Region 6	62.7	34.1	51.5	71.8
Oneida County*	66.4	35.6	55.0	100.4
Other counties	60.9	33.3	51.7	66.3
Region 7	59.0	27.8	47.0	65.0
Broome County*	63.1	26.7	56.9	102.4
Onondaga County*	69.4	38.1	71.5	117.1
Other counties	55.8	24.9	39.1	49.1
Region 8	65.8	32.8	58.9	93.1
Monroe County*	71.6	37.8	72.0	93.8
Other counties	63.8	31.0	55.2	94.9
Region 9	63.4	30.5	62.8	118.3
Eric County*	75.5	38.2	77.7	156.8
Other counties	52.6	24.4	49.9	89.8
Metropolitan areas	72.0§	40.7	74.3	111.6
Rural areas	60.5§	30.3	51.5	82.5
Total	65.0	33.8	59.2	91.3

* Metropolitan area.

§ Significantly different ($\chi^2 = 85.291$, 1 d.f.; $P > 0.95$).

current hunters would increase their participation if new opportunities were available. A majority of the hunters surveyed (65 per cent) reported that they would hunt more if they could find more land open to hunting (Table 9). Expanded conservatively to the entire population of active hunters in the State, this would represent about 284,000. For Regions 4, 5, 6, 7, 8 and 9 the proportion ranged from 57 to 66 per cent, while for Regions 1, 2 and 3 it was markedly higher, ranging from 73 to 77 per cent. Statewide, a significantly greater proportion of metropolitan than rural hunters (72 vs. 60 per cent, respectively) indicated that they would hunt more if additional lands were available.

Estimates of the potential increase were obtained by asking respondents how many more days they would hunt big game, small game and waterfowl if more hunting areas for such species were available and then comparing these data with the number of days respondents reported hunting such game in 1976. The results are given as percentages in Table 9. These estimates consider potential increases in participation by current hunters only.

Statewide, an increase of about 34 per cent could be expected for big game, ranging from 28 per cent for hunters from Region 7 to 53 and 54 per cent for hunters from Regions 2 and 1, respectively. The potential increase was somewhat greater for metropolitan than rural hunters.

For small game the average increase would be about 60 per cent, ranging from 46 per cent for Region 5 to 89 per cent for Region 2 and 105 per cent for Region 1. As with big game, the potential increase was greater for metropolitan than rural hunters.

For waterfowl the average increase would be about 91 per cent, but a great deal of variation was found between regions, ranging from a moderate increase of 65 per cent for Region 7 to an extremely large increase of 300 per cent for hunters residing in Region 2. Metropolitan hunters indicated they would increase their waterfowl hunting more than rural hunters. The greater potential increase for waterfowl hunting should be considered in light of the relatively small number of total hunter days currently expended, compared with big game and small game hunting.

TABLE 10. ESTIMATED TOTAL INCREASE IN HUNTER DAYS IF MORE LAND WERE AVAILABLE

Class of game	Number of days (in thousands)*
Big game	1,409 ± 54
Small game	2,931 ± 118
Waterfowl	676 ± 50

* Expansions at $P > 0.95$.

The data were expanded to represent the increase in hunter days for the entire population of active hunters in the State (Table 10).

WILLINGNESS OF HUNTERS TO PAY FOR ACCESS TO PRIVATE LANDS

Although the State's Fish and Wildlife Management Act provides a mechanism for increasing hunter access to private lands, expansion of this program by the Department of Environmental Conservation is limited by budget constraints. Consequently, alternatives are under investigation, among which are direct or indirect subsidies to landowners. This approach is not widely used and little is known about how much, or whether or not, New York State hunters would be willing to pay for hunting privileges. One indication of the potential for this type of program is the amount a hunter would pay as a day-use fee; therefore this information was requested on the questionnaire.

Statewide, 56 per cent of the big game hunters surveyed were willing to pay a day-use fee to hunt on private land, assuming good hunting conditions. Nearly a third indicated they would pay \$5 per day, but only 12 per cent would pay in excess of that. Respondents from Regions 1, 2 and 3 showed the greatest interest in this type of program. These regions had the smallest proportions of big game hunters who were unwilling to pay for hunting access, and the greatest proportions who would pay moderate fees. A slightly greater proportion of rural than metropolitan hunters indicated an unwillingness to pay a day-use fee.

Statewide, 53 per cent of the small game hunters surveyed reported they were willing to pay a day-use fee. Of these, 21 per cent would pay \$5 per day, but only 6 per cent would pay more than that. Respondents from Regions 1 and 2 were more inclined to pay a day-use fee than those from other regions, and metropolitan hunters were more willing than rural hunters to pay such a fee.

Waterfowl hunters were only slightly less willing than big game hunters to pay a day-use fee, 47 per cent being unwilling to pay any amount. While 28 per cent would pay \$5 per day, only 11 per cent would pay more. Respondents from Regions 1 and 2 were more willing than those from other regions to pay a fee. In Region 2, 71 per cent would pay \$5 per day, and 40 per cent would pay as much as \$10 per day. Again, a greater proportion of metropolitan than rural hunters would pay a day-use fee for access to private lands.

Generally, there was limited interest among the hunters sampled in the concept of paying a day-use fee to private landowners for hunting privileges, although a slight majority indicated a willingness to pay some amount. Respondents from highly urbanized Regions 1 and 2 were the most receptive to paying such a fee, regardless of the type of

hunting considered. They also indicated a willingness to pay higher amounts as maximum fees than did hunters from other regions. State-wide, metropolitan hunters indicated they would pay significantly higher fees than rural hunters for hunting all types of game. Also, the proportion who would pay a fee was significantly greater for hunters who reported a posting problem than for those who did not (60 vs. 47 per cent, respectively). These trends applied to all types of hunting.

HUNTERS' EVALUATION OF FWMA COOPERATIVE HUNTING AREAS

New York State has had a program for facilitating hunting access to private lands for over 20 years under the Fish and Wildlife Management Act. This voluntary cooperative program has not been evaluated previously from the hunters' viewpoint. Therefore, a segment of this study was devoted to determining their awareness of the FWMA program, their use of existing cooperative hunting areas and their feelings about various aspects of them.

TABLE 11. PROPORTION OF RESPONDENTS WHO WERE AWARE OF FWMA PROGRAM AND PROPORTION WHO HAD HUNTED ON SUCH AREAS (IN PER CENT)

Area of residence	Proportion aware of program	Of those aware of program, proportion who had hunted on such an area in 1976
Region 1*	41.0	26.5
Region 2*	38.1	22.1
Region 3	49.1	28.2
Region 4	41.9	33.8
Albany County*	37.2	33.0
Other counties	43.5	33.7
Region 5	29.2	18.9
Region 6	27.2	15.5
Oneida County*	27.4	16.4
Other counties	26.6	14.4
Region 7	34.0	16.6
Broome County*	44.8	18.8
Onondaga County*	26.4	15.6
Other counties	33.5	16.9
Region 8	30.9	19.9
Monroe County*	30.2	26.8
Other counties	31.4	18.5
Region 9	33.0	22.2
Erie County*	30.7	25.5
Other counties	34.7	20.4
Metropolitan areas	34.0	23.3
Rural areas	36.3	23.1
Total	35.4	23.2

* Metropolitan area.

AWARENESS AND USE OF AREAS Slightly more than one-third of the active hunters surveyed (from 27 per cent in Region 6 to 49 per cent in Region 3) were aware of the FWMA program (Table 11). Hunters from Regions 1, 2, 3 and 4 tended to be somewhat more aware of it than those from other regions. Statewide, no significant difference was found between metropolitan and rural hunters in this respect.

Of those hunters who were aware of the FWMA program, 23 per cent (an estimated 35,900 hunters statewide) reported that they actually had hunted on such an area in 1976. Regionally, for those respondents who knew of the program, the proportion who had hunted on an FWMA area varied from 16 per cent for Region 6 to 34 per cent for Region 4. The proportion was greater for hunters from Regions 1, 3 and 4 than for those from other regions, but it was identical for metropolitan and rural hunters generally.

AVAILABILITY AND SIZE Nearly half of the hunters who were aware of the FWMA program felt that too few such areas were available. About 14 per cent believed enough areas existed, while less than 2 per cent believed there were too many. The proportion who felt there were too few areas varied from 41 per cent in Region 7 to 62 per cent in Region 2 and was greatest in Regions 1 and 2. A significantly greater proportion of metropolitan than rural hunters believed too few FWMA areas existed.

REGULATIONS About 44 per cent of the hunters who were aware of the FWMA areas indicated they didn't know about the convenience of the check-in procedures. Of those offering an opinion, 69 per cent felt that these procedures were convenient or satisfactory, and 31 per cent considered them inconvenient. Statewide, there was no significant difference in the responses of metropolitan and rural hunters. The greatest proportions of hunters who thought the procedures were inconvenient were from Regions 1, 2 and 3 (28, 26 and 29 per cent, respectively), while the lowest proportion was from Region 5.

Most hunters (61 per cent) who were aware of the FWMA areas felt that regulations on them were satisfactory. Only 5 per cent believed they were too strict, and about 33 per cent said they didn't know. The proportions of respondents who felt the regulations were satisfactory ranged from 70 per cent for Regions 1 and 2 to 51 per cent for Region 5. The proportions who felt they were too strict ranged from only 2 per cent for Regions 5 and 8 to 10 per cent for Region 3. While no striking differences were observed between respondents from rural and metropolitan counties within regions, they differed significantly statewide.

HUNTING CONDITIONS Attitudes toward the number of hunters present on FWMA areas varied considerably for respondents who were

aware of these areas. Statewide, although nearly 43 per cent had no opinion, 31 per cent thought there were too many hunters and 26 per cent thought the number was satisfactory. For respondents who thought there were too many hunters, the proportions were greatest in Regions 1, 2 and 3 (42, 48 and 41 per cent, respectively) and smallest in Region 7 (21 per cent). Statewide, the responses of metropolitan and rural hunters were not significantly different.

Few of these hunters (7 per cent) considered the amount of game present on the FWMA areas to be good. About 30 per cent assessed game abundance as fair, 25 per cent assessed it as poor, and 38 per cent didn't know. Statewide, more metropolitan than rural hunters considered game abundance on these areas to be poor, while more rural hunters considered it to be fair.

CONVENIENCE Statewide, about 44 per cent of the hunters who were aware of the FWMA areas reported that the travel distance to such areas was convenient, 29 per cent felt it was too far, and 27 per cent didn't know. The proportion who believed it was convenient varied from 56 per cent for Region 1 to 39 per cent for Regions 5 and 7, while for those who believed the distance was too far it varied from about 40 per cent for Region 2 to about 23 per cent for Region 4. Statewide, a significantly greater proportion of metropolitan than rural hunters indicated that the distances were too far.

DISCUSSION

In using the results of this study as an aid for evaluating access to private lands in New York for hunting, it is important to keep in mind their limitations. Perhaps the greatest limitation is that the sample of hunters analyzed was drawn from those who had a resident hunting license in a single year, i.e., 1975-76. Thus, the data technically apply only to the experiences of those hunters. While one would expect similar responses from the State's hunters over the following few years, it is important to note that at best data were obtained only for active hunters. In particular, the study sheds no light on the degree to which access-related problems served as a deterrent to people who might have adopted hunting as a leisure activity or caused former hunters to stop hunting.

The degree to which posting and other access problems significantly hinder active hunters varied relatively little throughout the State. While some significant differences were found where samples were large, the proportions of hunters who reported encountering posting and other access problems were generally very similar for those residing in metropolitan areas and those residing in rural areas. Likewise, differences between the administrative regions of the Department of Environmental Conservation were not great.

If only the reported incidence of posting problems *per se* were considered, the findings might be construed as indicating that, at the time of the study, such difficulties did not seriously hinder the activities of active hunters. Only a third of the respondents reported experiencing posting problems, and the statewide median for the proportions in the various counties varied from a high of only 23.5 per cent for pheasant to a low of 11.0 for ruffed grouse. Furthermore, the proportions for metropolitan hunters averaged only one or two percentage points higher than those for rural hunters.

On the other hand, when the data on posting are considered in conjunction with the information concerning other access problems (crowding, lack of information on hunting areas, lack of parking and poor road access to huntable areas) it seems evident that these problems collectively did exert a dampening effect on hunting activity. Approximately 20 per cent of all hunter days afield involved situations where the hunting destination was not known in advance. Heavy posting in many areas of the State strongly limited the choice of areas for those who did not already have a place to hunt. The majority of respondents (65 per cent) indicated that they would hunt more if they could find more land open to hunting. Given convenient hunting access, respondents indicated they would increase their days in the field by 34 per cent for big game, 60 per cent for small game and 91 per cent for waterfowl. Younger hunters, especially those 25 years old or under, encountered significantly more access problems than did older, more experienced hunters. This could be an important factor affecting the recruitment of young people into recreational hunting.

Only 35 per cent of the respondents were aware of the FWMA cooperative areas, and only 8 per cent had hunted on such an area in 1976. The majority of those familiar with these areas felt that they were somewhat crowded and rated game abundance on them as only fair to poor. However, it may be that some areas are not being used to capacity and could be hunted more heavily. Also, evaluation of habitat conditions together with game harvest records might indicate opportunities for substituting more productive areas.

Most hunters indicated a preference for private lands. They also indicated that they would hunt more if better access were available. The need for expanded hunting access is probably greatest in Region 3, not only because of problems encountered by hunters residing there, but also because of the degree to which residents of Regions 1 and 2 hunt there. New York City and Long Island residents indicated a moderate willingness to pay for access to private lands for all types of hunting. While willingness to pay fees of this sort was less for upstate residents, approximately 70 to 75 per cent of the respondents in the

Albany, Syracuse, Rochester and Buffalo areas stated that they would hunt more if additional hunting areas were available. Therefore, in addition to the possibility of improving existing FWMA areas, consideration might be given to leasing private acreage for hunting and requiring hunters using it to purchase a special license or stamp.

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LIMITATIONS ON POTASSIUM PERMANGANATE DETOXIFICATION OF ANTIMYCIN¹

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ABSTRACT

Potassium permanganate rapidly detoxifies antimycin to a toxicity level equivalent to about 4 per cent of the original concentration. From there on, the detoxification is quite slow. Detoxification is more rapid at high pH values and may be more effective at low temperatures. Use of antimycin-potassium permanganate systems in fish control would probably entail undue risks in most situations involving antimycin-sensitive fish, soft water and a need for rapid detoxification. Artificial pH adjustment would be feasible in some instances, but would require additional precautions.

Antimycin is a commonly used fish toxicant. Its detoxification by potassium permanganate (KMnO_4) was first reported by Berger (1967). It is a common fisheries management procedure in the upper Midwest to treat a target water with 5-10 ppb of antimycin, and to protect desirable downstream fish populations by introducing potassium permanganate at a concentration of at least 1 ppm. Winter treatments are common.

In testing any toxicant-detoxicant system, there are a number of coarse and fine procedures that may be used. A crude measure of detoxification rate can be obtained by adding a detoxicant to a toxic dispersion of known concentration, waiting a given number of minutes, then adding bioassay fish and noting whether they survive. The difficulty with this procedure is that detoxification continues after the fish are added. It simulates the situation that would occur in a pond, or in a stream if the affected fish turned tail and migrated downstream with the detoxifying mixture. This behavior does not usually occur with rotenone treatment at moderate concentrations (Engstrom-Heg and Loeb, 1971) and is even less likely to occur with antimycin, which is marketed in a non-repellent formulation.

There are two main roads around this difficulty. An obvious one is removal of the detoxicant before the fish are added. Cohen et al. (1960) and Engstrom-Heg (1964) did this by mechanical filtration in the case of rotenone and activated carbon. Engstrom-Heg (1972) studied the kinetics of rotenone-potassium permanganate systems by chemically reducing the permanganate and thus arresting the detoxification. Tan-

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nic acid was used as the reducing agent. It was found that it reduced the permanganate quickly and efficiently, that the reaction products were not acutely toxic to fish, and that neither the tannic acid nor the reaction products had any measurable effect on the toxicity of low concentrations of rotenone.

Residual rotenone concentrations were estimated by bioassay, with reference to an empirically determined concentration-response curve (Loeb and Engstrom-Heg, 1971). The results were quite satisfying. The kinetics proved to be very simple for moderate rotenone concentrations, with detoxification occurring at a single negative exponential rate directly proportional to the permanganate concentration. This situation, of course, depended on a large excess of permanganate ions over rotenone molecules. At high rotenone concentrations, the pattern was complicated by the presence of toxic decomposition products and colloidal rotenone. Despite its successful use in this instance, it is recognized that this method has inherent dangers. Use of a third chemical, the reducing agent, introduces an extraneous variable that could have a variety of subtle chemical or biological effects.

A completely different method, based on a technique described by Marking (1972), was used by Marking and Bills (1975). In this approach, fish are added to reaction mixtures at a series of time intervals after addition of the detoxicant, beginning with zero time, and 96-hour LC_{50} 's are determined for each reaction time. The ratio of a given LC_{50} to the zero-time LC_{50} is called a deactivation index. The deactivation indices are proportional to the reciprocals of toxicant concentrations remaining at the end of the time intervals and may be used to plot a detoxification curve on semi-logarithmic paper. The method appears to be logically sound provided all extraneous conditions remain constant through the bioassay period. It proved to be an admirable tool for determining half-lives of antimycin at various pH values (Marking and Dawson, 1972). Distorted results are possible where an extraneous process plays a large role. Results obtained by Marking and Bills (1975) for permanganate detoxification of antimycin at pH 8.5 and 9.0 suggest that something of this nature may have occurred. The method requires a larger expenditure of time, aquarium space and manpower than the reduction method, but it has the advantages of not requiring a third chemical and of being based on the standard LC_{50} .

PRELIMINARY EXPERIMENTS

In the first series of experiments, brown trout (*Salmo trutta*) were added to jars containing reaction mixtures of antimycin and potassium permanganate at various time intervals after addition of the potassium permanganate. Survival occurred with 60-minute treatment of 10 ppb

antimycin with 3 ppm potassium permanganate. We then tried arresting the reaction with tannic acid. Over a wide range of exposure times and permanganate concentrations (up to 3 hours and 10 ppm) we repeatedly and consistently found evidence for a persistent, low-level residual toxicity. The fish died, typically on the second day, with symptoms identical to those observed in trout killed by low concentrations of antimycin, namely rupture of blood vessels in the fin membranes and epidermal sloughing, giving the fish a grayish, somewhat ragged appearance. Only when a reaction mixture (10 ppb antimycin and 3 ppm potassium permanganate) was left overnight (16 hours) before addition of tannic acid was a 48-hour survival obtained.

At first, an artifact associated with the reducing agent was suspected. Substantially the same results were obtained, however, when the permanganate was reduced with sodium thiosulfate, hydrogen peroxide, gallic acid and potassium gallate. Of these, gallic acid was found to be a superior reducing agent for laboratory use with potassium permanganate. Applied at a 1:1 ratio, it completely reduces permanganate to manganous ions almost instantly. An approximate 1:1 end point was confirmed colorimetrically, using a Bausch and Lomb Spectronic-20 spectrophotometer-colorimeter and the orthotolidine method (American Public Health Association et al., 1965). It was found that neither gallic acid nor tannic acid, nor their reaction products with potassium permanganate, had any measurable effect on the toxicity of low concentrations of antimycin (0.5 ppb) on brown trout, as long as enough reducing agent was added to insure complete reduction. When reaction products resulting from partial reduction to manganese dioxide or some of its complexes were added to the antimycin, survival times were increased, indicating some detoxifying effect from this weaker oxidizing agent. This effect was not observed with rotenone. In subsequent tests, gallic acid at a 1:1 ratio was used as the reducing agent. Addition of this weak acid at low concentrations did not measurably affect the pH of the mixtures.

Toxicity of antimycin is known to vary with temperature and with pH, though in the latter case variations in stability no doubt affect experimental results. Tests up to this point had been run in laboratory spring water (pH—6.7; TDS—23 ppm) at 18.3° C. (65° F.). It seemed possible that detoxification might occur more readily at lower temperatures. Tests were run at 8.3° C. (47° F.) and 11.7° C. (53° F.). Full detoxification as indicated by 48-hour survival was not obtained by treating 10 ppb antimycin with 2 ppm potassium permanganate for exposure periods of up to 3 hours at these temperatures.

LATER EXPERIMENTS

At this point, there appeared to be strong circumstantial evidence

of incomplete detoxification of antimycin in the water used, and perhaps in any soft water, but a more definitive series of tests was needed to confirm and quantify this finding. It was also felt that effects of pH on detoxification should be studied with an eye toward artificial adjustment of stream pH values for field application. We knew that reliable concentration-response curves could not be established for very low antimycin concentrations because of the very great variability in time to death. It was therefore decided to work with concentrations higher than would commonly be used in the field, but still low enough so that the permanganate concentration would remain essentially constant through the reaction period.

METHODS

All tests were conducted in laboratory spring water (pH—6.7, TDS—23 ppm, total alkalinity—14 ppm, potassium permanganate demand—negligible) or in the same water with the pH adjusted by adding potassium hydroxide and/or hydrochloric acid. Test vessels were 5-gallon jars containing 10 liters of water. Vessels were floated in a 500-gallon tank at a constant temperature of 12.8° C. (55° F.). Test fish were hatchery rainbow trout (*Salmo gairdneri*) ranging from 41 to 58 millimeters in total length and from 0.6 to 1.9 grams in weight. The fish were not fed during the 24-hour period before an experiment. Antimycin was introduced as Fintrol Concentrate, a commercial 10 per cent formulation, diluted to a 0.1 per cent stock solution with acetone. Potassium permanganate and gallic acid were introduced as 1 per cent aqueous stock solutions. Values for pH were determined to the nearest 0.1, using a Beckman Model G portable pH meter.

A concentration-response curve was derived for the test fish, based on determinations at 11 concentrations between 2 and 50 ppb antimycin. Five fish were added to each jar, and mean time to death was used as the response criterion. Results were plotted on full logarithmic paper (Figure 1) using the method of Burdick (1957) with threshold values of 20 minutes and 0.03 ppb. A regression line was fitted, having the equation

$$\log (T - 20) + 2.9598 = 1.0298 \log (C - 0.03)$$

where T is response time in minutes and C is antimycin concentration in ppb. Tests at lower concentrations down to 0.2 ppb suggested that the curve is valid in this range, but variability was high and precision low. An apparent 96-hour toxicity threshold occurred in the 0.1 to 0.2 ppb range. This differs from the 96-hour LC_{50} at 0.033 ppb reported by Marking and Bills (1975) for pH 6.5. Loading appears to have been similar (approximately 0.5 gram of fish per liter of water) compared with "less than 1 gram of fish per liter of water" as reported by Marking and Bills.

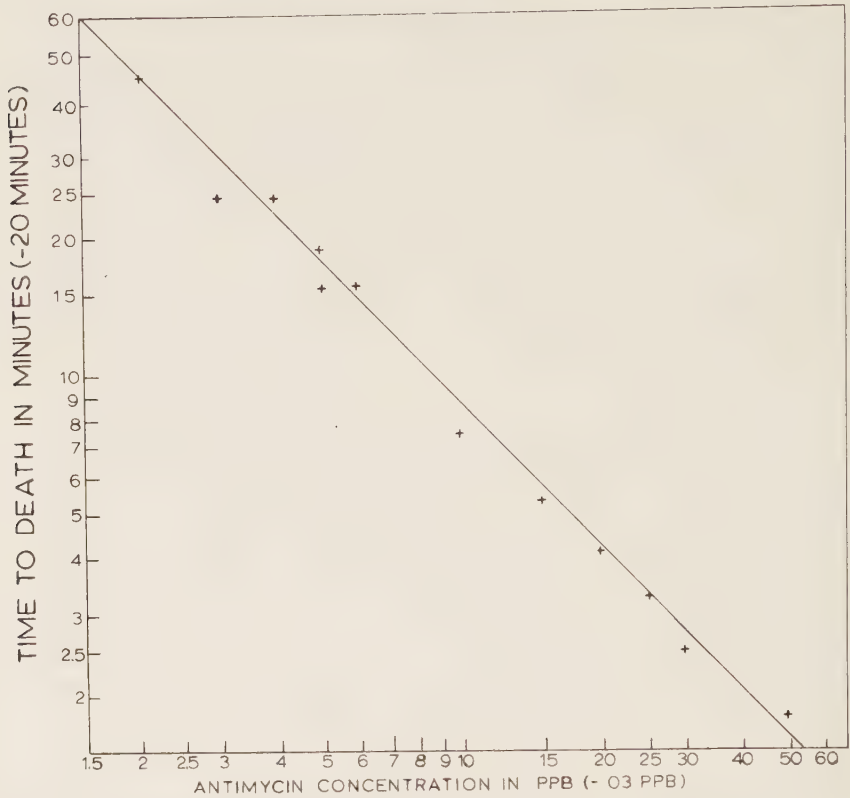


Figure 1. Antimycin concentration-response curve for rainbow trout.

In the first detoxification test, 20 ppb of antimycin was treated with 3 ppm of potassium permanganate over a series of reaction times ranging from 2 to 180 minutes. At the end of the reaction time the per-manganate was reduced by adding 3 ppm of gallic acid. Five trout were then added to the jar, and times to death were observed and recorded.

In the second test, 50 ppb of antimycin was introduced into water that had been treated the previous day with 0.014 gram of potassium hydroxide per liter to give a stable pH of 8.1. A hydroxide was used because possible field applications would require a substance that could change the pH by addition of quite small quantities. Jars were treated with potassium permanganate and gallic acid, as in the first test, over reaction times ranging from 5 to 60 minutes. The pH was adjusted to 6.7 by addition of hydrochloric acid before fish were added. The bioassays were conducted as in the first test. In addition to these two main tests, supplemental tests were conducted on 10 and 5 ppb antimycin concentrations, at pH values of 8.1 and 6.7, using the same procedures.

RESULTS

The initial phase of detoxification was indeed rapid. The first half-life at pH 6.7 was slightly over 2 minutes, which, if reaction rates are proportional to potassium permanganate concentrations, corresponds well with the figure of 6.2 minutes indicated in the data given by Marking and Bills (1975) for antimycin treated with 1 ppm potassium permanganate at pH 6.5. After the first few minutes, however, the reaction slowed down (Figure 2). Changes in residual concentration after the first hour suggest a half-life of about 2 hours at this stage. The detoxification pattern at pH 8.1 (Figure 3) was similar, but more rapid. Both tests confirm the presence of a slowly detoxifying chemical species at a toxicity level corresponding to about 4 per cent of the original antimycin concentration. This could be a less-toxic breakdown product of antimycin, or it could be antimycin itself in some complexed or adsorbed form. For comparison, the detoxification rates obtained from Marking and Bills' deactivation indices at pH 6.5 and 7.5 were tripled to correspond to 3 ppm of potassium permanganate and plotted on the same graphs with our data. The correspon-

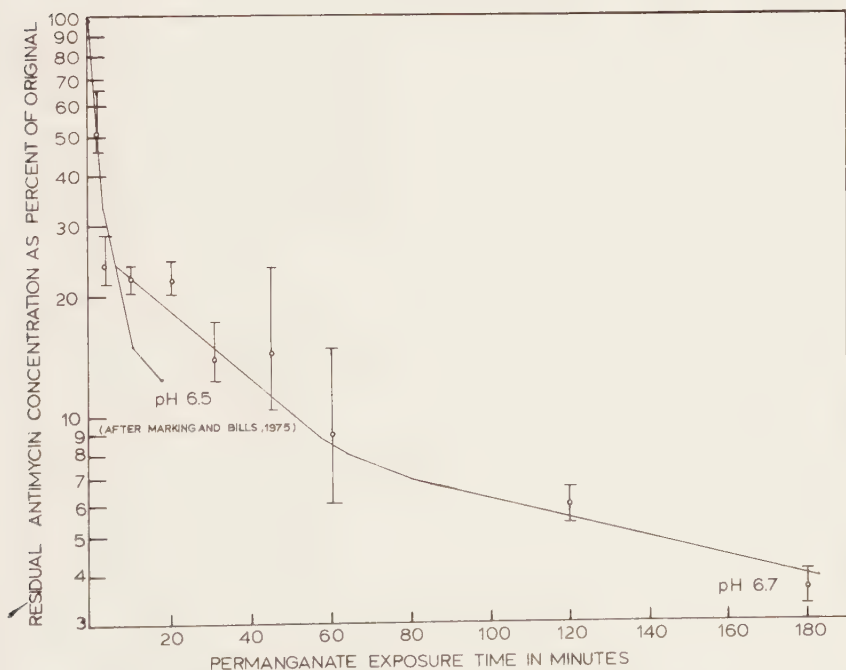


Figure 2. Detoxification of antimycin by 3 ppm potassium permanganate in soft water. Estimated residual concentrations are shown $\pm$ standard deviation. Exposure times reported by Marking and Bills (1975), based on 1 ppm potassium permanganate, have been divided by three for comparability.

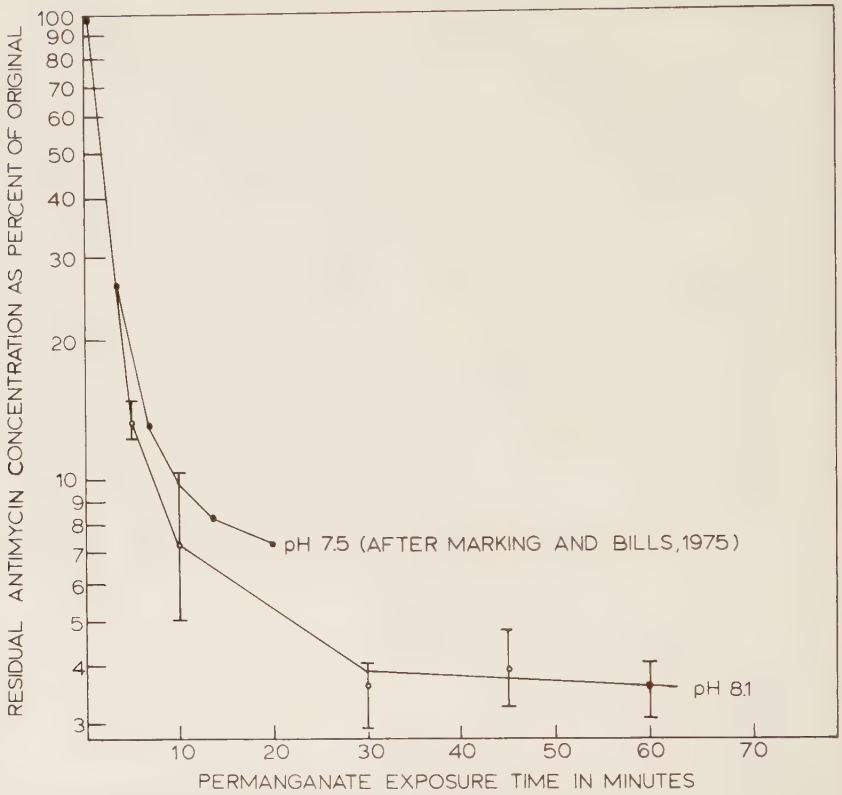


Figure 3. Detoxification of antimycin by 3 ppm potassium permanganate in water adjusted to pH 8.1. Estimated residual concentrations are shown $\pm$ standard deviation. Exposure times reported by Marking and Bills (1975), based on 1 ppm potassium permanganate, have been divided by three for comparability.

dence between our results at pH 8.1 and theirs at pH 7.5 is remarkable. That between our data at pH 6.7 and theirs at pH 6.5 is at least fair.

Antimycin at 10 ppb in water adjusted to pH 8.1 was not fully detoxified by 3 ppm of potassium permanganate within a 60-minute reaction period. Similar solutions containing 5 ppb of antimycin were non-toxic to rainbow trout after 30 minutes of treatment. At 10- and 15-minute reaction times they were not. Attempted detoxification of 5 ppb antimycin with 3 ppm potassium permanganate at pH 6.7 was unsuccessful at 180 minutes. It was concluded that potassium permanganate would fully detoxify 5 ppb antimycin within 30 minutes at pH 8.1, but that rapid detoxification was not feasible at higher concentrations or much lower pH values.

It was found that an alkaline stock solution containing 2.5 grams of

potassium permanganate and 12.5 grams of potassium hydroxide per 100 milliliters of water could be prepared and was stable on storage. When added to a 5 ppb antimycin solution in laboratory water at 3 ppm of potassium permanganate, it raised the pH to 8.0 and detoxified the antimycin within 30 minutes. This stock solution corroded aluminum but had no significant short-term effects on iron.

DISCUSSION

These experimental findings correspond closely with those of Marking and Bills (1975), but our interpretation of them does not, perhaps because the experimental method used permitted observing the death of a good many fish in solutions that "should have been" detoxified. Marking and Bills stated that antimycin is "rapidly detoxified by 1 mg/liter of KMnO_4 in waters of pH 6.5 to 9.5" and concluded that potassium permanganate is an "excellent detoxifier" for antimycin. We would add the important qualification that the pH must be relatively high and the antimycin concentration relatively low, or else the time allowed for detoxification must be quite long. Marking and Bills did recognize that detoxification was non-linear on a semilogarithmic scale and that it was more rapid initially. However, they attributed this to loss of available permanganate through reaction with antimycin. This is unlikely. At molar ratios in excess of 68 permanganate ions for each antimycin molecule (their minimum at pH 7.5), significant loss of permanganate would not be expected. Non-trivial permanganate demands can be readily observed as color changes, and can be measured (Engstrom-Heg, 1971). Although the demand was not measured in the present study, no visual evidence for significant permanganate loss was seen in any of the tests.

Use of half-lives assumes a decay curve corresponding to a single negative exponential rate, which does not occur with antimycin and potassium permanganate. The initial half-life estimated by Marking and Bills (1975) for antimycin treated with 1 ppm potassium permanganate at pH 6.5 suggests that full detoxification of a 10 ppb solution to their LC_{50} value of 0.033 ppb would require about 50 minutes. If the half-life based on their final 3 points is used, detoxification would require about 4.5 hours. If our final half-life for pH 6.7 (2 hours) is used, detoxification with 3 ppm potassium permanganate would require about 8 hours, which agrees with our preliminary finding of detoxification at 16 hours but not at 3 hours.

It is possible that low residual antimycin concentrations are broken down more rapidly in actual stream conditions than our tests suggest. Photodecomposition would probably be an important factor, at least during daylight hours. Adsorption and biological uptake might also play significant roles.

Decisions to use or not use an antimycin-permanganate system in a field application must be based on individual cases. In general, there would be little risk if the fish to be protected were fairly resistant to antimycin (e.g., bass, walleye), if the pH were 8.0 or over in combination with a 5 ppb treatment, if an intervening impoundment or a reach of sluggish stream made a long reaction time possible, or if there were a large dilution factor. The risk would probably be unacceptable if the situation called for protecting a significant salmonid population in soft water through rapid detoxification in the absence of a large dilution factor. Intermediate cases would have to be weighed on their merits. Based on what is known of antimycin, additional factors favoring rapid detoxification would be low temperature, clear water and sunlight. Slower detoxification might be expected with high temperature, deep shade, high turbidity or a need to continue detoxification through the night.

Artificial pH adjustment (using an alkaline stock solution of potassium permanganate is feasible, at least for small streams in the neutral to slightly acid category. However, it would require that all metallic fittings in the application apparatus be of stainless steel or brass, rather than aluminum, and would present an additional hazard to the applicators, who would be required to work with highly caustic materials. Protective clothing would be essential. In view of the availability of other toxicant-detoxicant systems, this approach would not often be the first choice.

Field use of a reducing agent such as sodium thiosulfate to remove excess potassium permanganate after detoxification is not generally recommended for antimycin because of the uncertainty in determining when detoxification is complete. In very hard water with a low permanganate demand, where excess permanganate might be toxic to fish, partial reduction to tetravalent manganese, using equal concentrations of potassium permanganate and sodium thiosulfate, might be attempted. The reduction product would continue to have some detoxifying effect on any residual antimycin.

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WATERFOWL PRODUCTION ON BEAVER FLOWAGES IN A PART OF NORTHERN NEW YORK¹

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ABSTRACT

Waterfowl were observed on three occasions at least a week apart during late May, June and early July in 1973 on selected beaver flowages in four ecological sections (Taconic, Central Adirondack, Adirondack Foothills and Mohawk) in Region 5S comprising Fulton, Hamilton, Saratoga, Warren and Washington Counties in New York. The flowages were classified as new active, old active or abandoned. The principal species were wood duck, black duck, hooded merganser and mallard. Frequencies in terms of number per flowage and number per acre for adults, broods and ducklings were derived as indices of waterfowl use and production. New active flowages were used to a greater degree than the other classifications. The contribution of beaver flowages to waterfowl production was greatest in the Taconic section. However, it is concluded that the use of such flowages is sufficient in all sections of Region 5S to warrant a management program for beaver that would in turn benefit waterfowl. The relationship of such a program to beaver damage problems is also discussed.

Few specific data have been available regarding the relationship of beaver flowages to waterfowl production in northern New York. Such information is needed for planning beaver management, and a study was undertaken to obtain an index of waterfowl production on selected wetlands created by beaver in Region 5S (one of the administrative regions of the Department of Environmental Conservation). The present paper summarizes data from waterfowl observations in the late spring and early summer of 1973.

Region 5S (i.e., the study area) comprises the counties of Fulton, Hamilton, Saratoga, Warren and Washington. Five ecological sections, as defined by Dickinson (1969), are represented in this area, and waterfowl observations were made on four of them, i.e., Taconic, Central Adirondack, Adirondack Foothills and Mohawk (Figure 1), on flowages selected on the basis of present or historical use by beaver. Following are the pertinent characteristics of these four sections, based on the descriptions of Dickinson except for recent wildlife information.

THE TACONIC SECTION comprises a land area of 392 square miles (8 per cent of the region) and includes part of Washington County. It is generally hilly with moderate slopes. Forest types range from scrubby, poor-form pioneer species (gray birch, black birch and red maple) to heavy stands of old-growth oak and

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Figure 1. Map of Region 5S showing ecological sections and locations (black dots) of beaver flowages on which waterfowl observations were made.

northern hardwoods. Valley soils are deep and fertile. About three-quarters of the land is in farms and slightly over 40 per cent is forested. Most of the land is owned by private individuals. Access is good with an average ratio of 300 acres per mile of highway. Human population density averaged about 45 persons per square mile (1960 census).

The trapping season for beaver in this section was closed from 1968 to 1974 resulting in an increase in the beaver population although it continued to be relatively low. In 1974, approximately 6 per cent of the potential colony sites were occupied (Brown, 1975). There were complaints of beaver damage in the valleys where flowages tend to conflict with intensive land use and human population levels.

Some suitable waterfowl habitat is scattered throughout this section, but no extensive wetlands exist. Most of this habitat involves the margins of lakes and ponds, streams, deadwaters and beaver flowages. The common species are the black duck, wood duck and mallard.

THE CENTRAL ADIRONDACK SECTION comprises a land area of 1,828 square miles (38 per cent of the region) and includes parts of Hamilton, Saratoga and Warren Counties. It is characterized by rounded mountains and forests of spruce, balsam fir and the true northern hardwoods (beech, yellow birch and sugar maple). Soils tend to be thin, acid and generally low in value. Forests occupy more than 95 per cent of the land area while less than 3 per cent is in farms. About 60 per cent of the land is owned by the State of New York and most of the remainder is held by large commercial companies or is in private estates. Access is limited with an average ratio of roughly 3,000 acres per mile of highway. Human population density averaged about two persons per square mile (1960 census).

The beaver is one of the most important wildlife species in this section and, according to Dickinson (1971), some two-thirds of the wetlands there consist of beaver flowages the status of which depends on the level of beaver activity. Complaints of beaver damage in this section were few.

Although not occurring in large numbers, various species of waterfowl are found throughout the Central Adirondack section on beaver ponds, deadwaters and permanent marshy ponds. The major species are the black duck, wood duck, hooded merganser and red-breasted merganser. Ring-necked ducks and goldeneyes are common in certain localities.

THE ADIRONDACK FOOTHILLS SECTION comprises a land area of 1,394 square miles (29 per cent of the region) and includes parts of Fulton, Hamilton, Saratoga, Warren and Washington Counties. The topography varies from rolling to moderately rough, consisting primarily of hills and rounded mountains. Hardwood types include a mixture of northern hardwoods, pioneer hardwoods and oak, while white pine occurs in concentrated stands on the lower slopes and valley edges. Soils are mostly coarse, well-drained, deep sands and gravel. About 90 per cent of the rural lands (exclusive of villages) is forested, while less than 15 per cent is in farms. Forest lands range from small woodlots to extensive timber holdings. Most of the land is privately owned, but about 36 per cent is in State ownership. Accessibility is moderate with an average ratio of about 500 acres per mile of highway. Human population density averaged 20 persons per square mile (1960 census).

The importance of beaver in this section is comparable to that in the Central Adirondack section. There are more damage complaints because of the more intensive land use and the higher human population.

Although suitable waterfowl habitat is confined to a relatively small proportion of the total area, beaver flowages, permanent marshy areas and deadwaters support black ducks, wood ducks, hooded mergansers and other species.

THE MOHAWK SECTION comprises a land area of 349 square miles (7 per cent of the region) and includes parts of Fulton and Saratoga Counties. It is gently rolling to hilly. The forest cover is generally intermediate between the northern hardwood and oak-hickory associations. Soils are mostly well-drained and highly productive. About 50 per cent of the rural land is devoted to farming with less than 30 per cent of the farm acreage being wooded. Most of the land is in private ownership. Access is good with an average ratio of 330 acres per mile of highway. Human population density (outside the cities) averaged about 55 persons per square mile (1960 census).

Although there is good beaver habitat in this section, beaver occupancy is limited by land use and human population levels. Beaver trapping was prohibited in Fulton County from 1968 to 1972, and there were a considerable number of damage complaints annually as the population increased.

Waterfowl habitat is limited to the small natural wetlands, beaver flowages and a few man-made bodies of water scattered throughout the section. The common species are the black duck, mallard, wood duck and hooded merganser with others such as green-winged teal, blue-winged teal and Canada goose being found at times.

PROCEDURE

Each flowage studied was classified according to beaver activity, using a modification of the criteria developed by Nevins (1966) and Spencer (1957).

New active flowage—beaver present, live flooded timber present

Old active flowage—beaver present for period of time, no live flooded timber

Abandoned —beaver not present, but history of long occupation by beaver; impounded water present but level below that when flowage was active; no live flooded timber

TABLE 1. NUMBER AND SIZE OF BEAVER FLOWAGES STUDIED, ACCORDING TO CLASSIFICATION, IN EACH ECOLOGICAL SECTION

Classification	Flowages studied*		
	Number	Total Acres	Proportion (per cent)
Taconic			
New active	2	43	12.6
Old active	1	70	20.6
Abandoned	3	227	66.8
Total	6	340	100.0
Adirondack Foothills			
New active	3	20	10.5
Old active	3	54	28.3
Abandoned	4	117	61.2
Total	10	191	100.0
Central Adirondack			
New active	2	30	25.2
Old active	4	80	67.2
Abandoned	1	9	7.6
Total	7	119	100.0
Mohawk			
New active	2	11	18.3
Old active	2	21	35.0
Abandoned	2	28	46.7
Total	6	60	100.0
Total			
New active	9	104	14.7
Old active	10	225	31.5
Abandoned	10	381	53.8
Total	29	710	100.0

* Number of visits: Taconic, 18; Adirondack Foothills, 29; Central Adirondack, 21; Mohawk, 18; total, 86.

The number and size of the flowages studied in each ecological section are summarized according to classification in Table 1, together with the proportion represented by each classification.

During late May, June and early July in 1973 all the selected flowages were visited three times at least a week apart. On each occasion, observations were made for at least 1½ hours beginning at approximately 6:30 a.m. and again for 2 to 3 hours before sunset. Observations at a specific flowage were made by quietly approaching to an elevated vantage point and scanning the impoundment. If all the open water in a unit could not be seen from one point, more than one observer was used, with observations being made concurrently. Observations recorded included the time spent, weather, beaver activity, water level and nature of vegetation together with the species, age and sex of waterfowl seen.

FINDINGS

The numbers of adults and young of each species, as well as of unidentified waterfowl, recorded are summarized in Table 2 for each ecological section, together with the relative abundance of each species. The relative abundance of broods of each species is also given. In Tables 3 and 4, the data for the several species are presented according to population density on the flowages in each classification.

The greatest number of waterfowl were observed in the Taconic section where adults and ducklings combined numbered 343 on the six flowages studied. This was followed by the Adirondack Foothills (128

TABLE 2. WATERFOWL AND WATERFOWL BROODS OBSERVED ON THE BEAVER FLOWAGES STUDIED IN EACH ECOLOGICAL SECTION

Species	Ecological section				Total
	Taconic	Adirondack Foothills	Central Adirondack	Mohawk	
Adults					
Black duck	16	14	13	3	46
Wood duck	33	17	4	6	60
Mallard	7	3	..	2	12
Hooded merganser	2	8	8	..	18
Unidentified	34	1	1	1	37
Total	92	43	26	12	173
Ducklings					
Black duck	25	21	12	9	67
Wood duck	163	43	..	5	211
Mallard	6	4	..	4	14
Hooded merganser	5	16	25	..	46
Unidentified	52	1	..	..	53
Total	251	85	37	18	391

TABLE 2. (continued)

Total Waterfowl					
Black duck					
Number	41	35	25	12	113
Per cent	12.0	27.3	39.7	40.0	20.0
Wood duck					
Number	196	60	4	11	271
Per cent	57.1	46.9	6.3	36.7	48.1
Mallard					
Number	13	7	..	6	26
Per cent	3.8	5.5	..	20.0	4.6
Hooded merganser					
Number	7	24	33	..	64
Per cent	2.0	18.7	52.4	..	11.3
Unidentified					
Number	86	2	1	1	90
Per cent	25.1	1.6	1.6	3.3	16.0
Total					
Number	343	128	63	30	564
Per cent	100.0	100.0	100.0	100.0	100.0
Broods					
Black duck					
Number	5	3	3	2	13
Per cent	12.8	15.8	37.5	50.0	18.6
Wood duck					
Number	22	8	..	1	31
Per cent	56.4	42.1	..	25.0	44.3
Mallard					
Number	1	2	..	1	4
Per cent	2.6	10.5	..	25.0	5.7
Hooded merganser					
Number	2	5	5	..	12
Per cent	5.1	26.3	62.5	..	17.1
Unidentified					
Number	9	1	..	..	10
Per cent	23.1	5.3	..	..	14.3
Total					
Number	39	19	8	4	70
Per cent	100.0	100.0	100.0	100.0	100.0

on 10 flowages), Central Adirondack (63 on seven flowages) and Mohawk (30 on six flowages). In terms of relative abundance on an acreage basis, the figures were 1.01, 0.67, 0.53 and 0.50, respectively.

The species identified, in order of abundance, were the wood duck, black duck, hooded merganser and mallard. Wood ducks and black ducks predominated in the Taconic and Mohawk sections, and these species plus the hooded merganser in the Adirondack Foothills. In the Central Adirondack section, however, the principal species was the hooded merganser, followed by the black duck, while the number of wood ducks was negligible. Mallards were encountered chiefly in the Mohawk section.

TABLE 3. WATERFOWL OBSERVED ON THE BEAVER FLOWAGES STUDIED, ACCORDING TO CLASSIFICATION, FOR EACH ECOLOGICAL SECTION AND RELATIVE ABUNDANCE BY SPECIES

Classification	Total waterfowl										Broods								
	Number per acre										Number per acre								
	Observed		Num- ber flow- age	Black duck	Wood duck	Mallard	Hooded meranser	Unidentified	Total	Observed		Num- ber flow- age	Black duck	Wood duck	Mallard	Hooded meranser	Unidentified	Total	
	Num- ber	Per cent								Num- ber	Per cent								
Taconic																			
New active	106	30.9	53.0	0.16	1.79	..	..	0.51	2.47	12	30.8	6.0	0.02	0.19	..	..	..	0.07	0.28
Old active	68	19.8	68.0	0.11	0.43	0.03	..	0.40	0.97	6	15.4	6.0	0.01	0.04	..	..	..	0.03	0.09
Abandoned	169	49.3	56.3	0.12	0.39	0.05	0.03	0.16	0.74	21	53.8	7.0	0.01	0.05	tr	0.01	0.02	0.09	0.09
Total	343	100.0	57.2	0.12	0.58	0.04	0.02	0.25	1.01	39	100.0	6.5	0.02	0.07	tr	0.01	0.03	0.12	0.12
Adirondack Foothills																			
New active	6	4.7	2.0	0.20	0.05	..	..	0.05	0.30	1	5.3	0.3	0.05	..	..	..	..	..	0.05
Old active	38	29.7	12.7	..	0.35	0.13	0.22	..	0.70	6	31.6	2.0	..	0.04	0.04	0.04	..	..	0.11
Abandoned	84	65.6	20.8	0.26	0.34	..	0.10	0.01	0.71	12	63.1	3.0	0.02	0.05	..	0.03	0.01	0.10	0.10
Total	128	100.0	12.8	0.18	0.31	0.04	0.13	0.01	0.67	19	100.0	1.9	0.02	0.04	0.01	0.03	0.01	0.10	0.10
Central Adirondack																			
New active	30	47.6	15.0	0.37	0.03	..	0.60	..	1.00	4	50.0	2.0	0.03	..	..	0.10	..	..	0.13
Old active	33	52.4	8.3	0.18	0.04	..	0.19	0.01	0.41	4	50.0	1.0	0.03	..	..	0.03	..	..	0.05
Abandoned	0	..	..	..	..	..	..	..	..	0	..	..	..	..	..	..	..	..	..
Total	63	100.0	9.0	0.21	0.03	..	0.28	0.01	0.53	8	100.0	1.1	0.03	..	..	0.04	..	..	0.07
Mohawk																			
New active	3	10.0	1.5	..	0.09	0.18	..	..	0.27	0	..	..	..	..	..	..	..	..	..
Old active	19	63.3	9.5	0.57	0.10	0.19	..	0.05	0.91	3	75.0	1.5	0.10	..	0.05	..	..	..	0.14
Abandoned	8	26.7	4.0	..	0.29	..	..	..	0.29	1	25.0	0.5	..	0.04	..	..	..	..	0.04
Total	30	100.0	5.0	0.20	0.18	0.10	..	0.02	0.50	4	100.0	0.7	0.03	0.02	0.02	..	..	..	0.07

TABLE 3. (continued)

Classification	Ducklings							•	
	Observed			Number per acre				•	
	Num- ber	Per cent	Num- ber per flow- age	Black duck	Wood duck	Mallard	Hooded merganser	Unidentified	Total
Taconic									
New active	90	35.9	45.0	0.14	1.60	..	..	0.35	2.09
Old active	48	19.1	48.0	0.10	0.36	..	..	0.23	0.69
Abandoned	113	45.0	37.7	0.05	0.30	0.03	0.02	0.09	0.50
Total	251	100.0	41.8	0.07	0.48	0.02	0.02	0.15	0.74
Adirondack Foothills									
New active	3	3.5	1.0	0.15	..	..	..	..	0.15
Old active	25	29.4	8.3	..	0.22	0.07	0.17	..	0.46
Abandoned	57	67.1	14.3	0.15	0.26	..	0.06	0.01	0.49
Total	85	100.0	8.5	0.11	0.23	0.02	0.03	0.01	0.45
Central Adirondack									
New active	14	37.8	7.0	0.07	..	..	0.40	..	0.47
Old active	23	62.2	5.8	0.13	..	..	0.16	..	0.29
Abandoned	0	..	..	..	..	..	..	..	..
Total	37	100.0	5.3	0.10	..	..	0.21	..	0.31
Mohawk									
New active	0	..	..	..	..	..	..	..	..
Old active	13	72.2	6.5	0.43	..	0.20	..	..	0.62
Abandoned	5	27.8	2.5	..	0.18	..	..	..	0.18
Total	18	100.0	3.0	0.15	0.08	0.07	..	..	0.30

TABLE 4. WATERFOWL OBSERVED ON THE BEAVER FLOWAGES STUDIED, ACCORDING TO CLASSIFICATION, FOR ALL THE ECOLOGICAL SECTIONS COMBINED AND RELATIVE ABUNDANCE BY SPECIES

Classification	Total waterfowl										Broods					
	Observed					Number per acre					Number per acre					
																Observed
Num-ber	Per cent	Num-ber	Per cent	Num-ber	Per cent	Num-ber	Per cent	Num-ber	Per cent	Num-ber	Per cent	Num-ber	Per cent	Num-ber	Per cent	
New active	145	25.7	16.1	0.21	0.77	0.02	0.02	0.17	0.22	1.39	17	24.3	1.9	0.03	0.03	0.03
Old active	158	28.0	15.8	0.15	0.24	0.06	0.13	0.12	0.13	0.70	19	27.1	1.9	0.02	0.01	0.08
Abandoned	261	46.3	26.1	0.15	0.36	0.03	0.10	0.05	0.10	0.69	34	48.6	3.4	0.01	0.01	0.09
Total	564	100.0	19.4	0.16	0.38	0.04	0.13	0.09	0.13	0.79	70	100.0	2.4	0.02	0.01	0.10

TABLE 4. (continued)

Classification	Ducklings											
	Number per acre										Total	
	Observed		Num-ber per flow-age	Black duck				Wood duck	Mallard	Hooded merganser		Unidentified
				Number per acre								
				Num-ber	Per cent	Num-ber	Per cent					
New active	107	27.4	11.9	0.11	0.66	0.04	0.12	0.14	0.12	0.07	1.03	
Old active	109	27.9	10.9	0.12	0.16	0.04	0.10	0.07	0.10	0.07	0.49	
Abandoned	175	44.7	17.5	0.08	0.28	0.02	0.03	0.06	0.03	0.06	0.46	
Total	391	100.0	13.5	0.09	0.30	0.02	0.07	0.08	0.07	0.08	0.55	

In terms of ducks observed per acre, for all the areas combined, the new active flowages ranked first in the degree of use by adults (1.39) as well as by broods (0.16) and ducklings (1.03). Use of the old active flowages and abandoned flowages was only about half as great, and there was little to choose between them. However, in the Taconic section where the preponderance of the ducks were observed, old active flowages were used much more than abandoned flowages. Whether or not an abandoned flowage had adequate, stable water was a major factor in its use by waterfowl. The strongest preference of a waterfowl species for a particular type of flowage was that of wood ducks for new active flowages in the Taconic section.

DISCUSSION

The data recorded provide index values for the degree of waterfowl use of the flowages studied in 1973. They furnish a basis for comparison with similar data for the same areas in subsequent years or with other areas. Also, given the aggregate acreage of such flowages in a section or region, they afford a means of calculating the total contribution of these areas to waterfowl production.

The findings indicate that the contribution of beaver flowages to waterfowl production was greatest in the Taconic section. Suitable natural breeding habitat for waterfowl is scattered throughout this section, but no extensive wetlands exist. Beaver flowages contribute significantly to wetland habitat and thus are important for waterfowl production. On the six areas where observations were made, over 150 acres of wetland had been created by beaver. An aerial survey in the fall of 1973 showed 28 active beaver colonies in this section of Washington County which, at the same ratio, represented 700 acres attributable to beaver activity. The data in Table 3 may be used to derive index values for the active flowages in this section, i.e., 0.16 brood per acre and 1.22 ducklings per acre. Using these values, waterfowl production on these flowages may be calculated as 112 broods and 854 ducklings.

Similar calculations may be made for the other sections provided the total acreage of flowages is known. The authors believe that the use of such flowages is sufficient in all sections of Region 5S to warrant a management program for beaver that would in turn benefit waterfowl. Black ducks and wood ducks would be the principal species benefited.

That beaver flows provide favorable habitat for waterfowl has been noted elsewhere in the Northeast and similar range. Mendall (1968) observed this in Maine and stated that proper management involved maintaining sufficient beaver to keep the habitat at a desirable stage.

Collins (1972) concluded that in southern Ontario there was a direct relationship between an increase in active beaver ponds and an increase in the duck population during the 20-year period from 1951 to 1971. Nevins (1966) noted that beaver ponds were important to wood ducks in New Hampshire.

At the same time it must be recognized that a program to increase the number or size of beaver flowages may entail nuisance problems. Some 60 per cent of the total time spent in servicing wildlife complaints in Region 5S involves nuisance beaver. The incidence of such complaints is much greater in the Taconic and Mohawk sections than in the Central Adirondack or Adirondack Foothills because of the more dense human population and related land-use patterns. The increase in beaver abundance and the number of active colonies in Fulton County (497 square miles) associated with a four-year closure of the trapping season was reported by Parsons and Brown (1978), together with a discussion of the attendant increase in damage complaints and the cost of servicing them. They found that the cost per colony of maintaining 194 colonies was about three times that of maintaining 150 colonies and concluded that maintenance of the latter population level was economically justified.

In evaluating a beaver management program designed to augment waterfowl production, the cost of servicing nuisance complaints must be compared with the cost of creating and maintaining small man-made wildlife marshes. In the Taconic section of Washington County in 1968, over \$2,800 was spent in maintaining 13 small marshes totalling 118.1 acres (i.e., approximately \$24 per acre). In the same part of Washington County in 1973, there were 28 active beaver colonies representing over 700 acres of wetlands. Nuisance complaints were associated with eight of these colonies and were handled at a cost of \$500 or less than \$1 per acre. With respect to relative waterfowl production, 72 brood counts on the same 13 marshes between 1962 and 1969 averaged 0.035 brood per acre, compared with 0.115 brood per acre observed during the present study of beaver flowages in the same territory.

In much of the area covered by this study, beaver management can result in high returns from wetlands in terms of both fur harvest and waterfowl production. The data indicate that the highest waterfowl production would be realized in the Taconic section. Beaver management would also be effective in the Adirondack Foothills. Although waterfowl production was lower in the Central Adirondack section, such management would be least costly there. It is concluded that, for the region as a whole, management of wetlands for beaver is more effective and more economical than constructing and maintaining man-made marshes.

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ELEMENTAL CONTENT OF AQUATIC ORGANISMS INHABITING A POND CONTAMINATED WITH COAL FLY ASH¹

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ABSTRACT

Using neutron activation and other methods, 39 elements were determined in algae, aquatic weeds, dragonfly nymphs, polliwogs, red-spotted newts, bullheads and muskrats from a pond contaminated by coal fly ash. The organisms contained several elements, including selenium, at concentrations markedly higher than those in controls.

When coal is burned in electric power-generating stations, the fly ash is trapped by electrostatic precipitators. Production of fly ash during 1976 was reported to be 42.8 million tons (Anonymous, 1977). A small percentage of the total produced is used as a base material for roadbeds and in concrete and ceramics, but the bulk of it is disposed of in landfills.

Plants grown on soils to which fly ash was added have been shown to have greater concentrations of arsenic, boron, calcium, iron, iodine, potassium, magnesium, molybdenum, antimony and selenium than control plants grown on untreated soils (Furr et al., 1976a). Sweet clover found growing voluntarily on beds of fly ash contained concentrations of selenium exceeding 200 ppm, dry weight (Gutenmann et al., 1976). When sweet clover grown on fly ash was fed to Guinea pigs, the animal tissues were found to contain markedly higher levels

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of selenium than the tissues of control animals fed clover grown on soil (Furr et al., 1975). In the work reported here, a number of aquatic organisms were sampled from a farm pond which was contaminated by fly ash. They were analyzed for 39 elements, and the concentrations recorded were compared with those found in organisms of the same sort taken from a control pond.

METHODS

Milliken Station is a coal-burning electric power-generating plant located in Lansing (N.Y.) about 20 miles north of Ithaca on the eastern shore of Cayuga Lake. At the time of this study, fly ash produced there was dumped at a large landfill site about 2 miles east of the plant. A farm pond about $\frac{1}{8}$ acre in area had been built at the landfill site and stocked with bullheads 3 years earlier. The pond was continually subjected to a drift of fly ash from nearby trucks that were unloading the material approximately every 20 minutes during daylight hours (450 tons per day). A layer of grayish ash particles coated the bottom of the pond and surrounding area.

A number of aquatic organisms were collected from the pond. These included sago pondweed (*Potamogeton pectinatus*), algae (*Zygnema* sp.), dragonfly nymphs (Libellulidae: *Platemis lydia*), polliwogs (*Rana clamitans*), red-spotted newts (*Notophthalmus viridescens*), bullheads (*Ictalurus nebulosus*) and muskrats (*Ondatra zibethicus*). Specimens of the same species were also taken from a farm pond located 16 kilometers away to serve as controls. Samples of bottom sediment from each pond were also taken for analysis. The pH of the water in the control and contaminated ponds was 6.7 and 7.7, respectively.

The aquatic weeds, algae, nymphs, polliwogs and newts and the livers from the bullheads and muskrats were thoroughly rinsed with distilled water, after which all samples were freeze dried, milled, mixed and subsampled for analysis. Each sample of nymphs, polliwogs and newts represented 30 replicated organisms which were combined prior to freeze drying and milling. The samples of pond sediment were freeze dried and mixed prior to being subsampled for analysis.

Non-destructive neutron activation analysis was used for determining 36 elements using the procedure described by Furr et al. (1976b). Selenium was determined by a modification of the fluorometric method of Olson (1969). Arsenic analysis was performed by dry ashing (Evans and Bandemer, 1954) and spectrophotometric determination of evolved arsine (Fisher Scientific Co., 1960). Boron was determined by the curcumin spectrophotometric procedure (Greweling, 1966).

RESULTS AND DISCUSSION

Table 1 lists the results of the analyses, except those for selenium,

TABLE 1. ELEMENTAL ANALYSIS, EXCEPT FOR SELENIUM, OF BOTTOM SEDIMENTS AND PLANT MATERIALS IN PONDS

Element	Concentration (ppm, dry weight)					
	Sediment		Pondweeds		Algae	
	Control pond	Fly-ash pond	Control pond	Fly-ash pond	Control pond	Fly-ash pond
Aluminum	46,400	99,700	691	11,900	5,127	27,400
Arsenic	9.8	103	9.6	84	27	9.6
Gold	0.01	0.01	..	0.02	..	0.02
Boron	10	26	300	250	138	130
Barium	480	320	..	..	..	..
Bromine	7.0	6.9	14	19	17	13
Calcium	4,220	6,760	47,500	15,660	78,900	15,650
Cerium	129	381	3.5	110	11	136
Chlorine	90	140	1,605	8,380	1,802	4,450
Cobalt	10.7	39	1.5	21	1.9	77
Chromium	37	142	1.4	8.4	6.5	22
Cesium	4.0	11	0.5	0.9	0.9	0.9
Copper	61	298	..	..	..	..
Europium	..	..	0.3	4.0	0.2	3.0
Iron	32,100	78,800	1,099	13,550	3,847	16,740
Hafnium	8.1	7.6	0.1	0.5	0.3	0.7
Mercury	3.0	4.3	0.9	0.1	0.3	1.0
Iodine	2.3	1.4	2.9	9	9.9	7.4
Potassium	10,900	12,600	10,740	15,770	13,380	18,800
Lanthanum	16	66	0.8	37	3.5	44.5
Lutecium	1.4	2.1	0.1	0.4	0.1	0.4
Magnesium	6,400	9,200	7,820	6,030	7,050	8,043
Manganese	241	161	251	393	681	959
Molybdenum	1.4	14	0.1	2.1	0.4	3.0
Sodium	5,290	2,100	8,526	4,834	1,186	959
Rubidium	..	..	..	16	..	3.7
Antimony	1.6	7.1	2.1	3.6	1.2	0.9
Scandium	4.1	34	0.1	5.6	0.7	5.6
Samarium	2.1	13	0.5	37	4.2	43
Strontium	..	..	627	..	..	..
Tantalum	0.2	0.9	..	1.0	..	0.3
Thorium	11	48	0.4	7.6	1.8	8.8
Titanium	2,770	7,840	34.4	360	286	390
Uranium	2.1	6.9	0.4	1.5	0.5	3.6
Vanadium	56	301	1.7	6.1	12	19
Tungsten	3.0	8.4	0.6	1.3	0.4	0.5
Ytterbium	2.4	4.0	0.3	2.0	0.4	2.8
Zinc	141	29	100	116	47	138

of bottom sediments, sago pondweed and algae from both ponds. Of the elements determined, all except gold, barium, hafnium, iodine, manganese, sodium and zinc were higher in concentration in the sediment from the pond contaminated with fly ash than in that from the control pond. The elements aluminum, cerium, chlorine, cobalt, chromium, europium, iron, hafnium, potassium, lanthanum, lutecium, manganese, molybdenum, scandium, samarium, thorium, titanium, vanadium, tungsten, ytterbium and zinc showed higher concentrations

in the plants from the contaminated pond than in the corresponding control plants. The sediment from the contaminated pond appeared to consist largely of fly ash, being typically light gray in color as compared with the dark color of the sediment from the control pond. Although the samples of aquatic weeds and algae from the contaminated pond were repeatedly rinsed with distilled water prior to subsampling for analysis, it is possible that some fly ash particles remained occluded in the plant material. Such particles may thus have contributed to the higher concentrations of certain elements in the plant samples from the fly-ash pond.

In Table 2 are shown the concentrations of elements, except selenium, found in nymphs, polliwogs, newts and the livers of bullheads and muskrats taken from the two ponds. The elements aluminum, cobalt, europium, iron, lanthanum, lutecium, samarium and titanium most consistently showed a higher concentration in the samples from the fly-ash pond.

Table 3 lists the concentrations of selenium found in aquatic samples from the ponds. The levels of selenium were consistently higher in those from the contaminated pond. Its presence was expectedly higher in the liver than the flesh of the bullheads, which is consistent with the findings of others as noted by Underwood (1971). Accumulation of selenium by marine organisms, when the substance was added to water as sodium selenite, has been reported (Fowler and Benyoun, 1976). This is presumably the inorganic form of selenium initially occurring in water contaminated with fly ash. However, conversion of selenium to toxic methylated derivatives by aquatic micro-organisms in bottom sediments has been reported (Chau et al., 1976).

The composition of fly ash varies considerably depending on the composition of the parent coal as well as conditions during coal combustion and fly-ash collection. Selenium is probably the element of most concern from a toxicologic standpoint. Plants growing on fly ash-amended soils absorb selenium roughly in proportion to the rate of fly-ash application (Furr et al., 1976a). Feeding such fly-ash grown seleniferous plants to animals results in marked deposition of selenium in animal tissues (Furr et al., 1975). Selenium is believed to be present in plants and ultimately animals as selenoamino acids in proteins, and these organic forms of selenium are much more readily absorbed by higher members of the food chain than are inorganic forms of the element. While selenium is an essential element for animals, the dietary range between essentiality (0.05 to 0.1 ppm) and toxicity (above about 5 ppm) is narrow (Underwood, 1971). However, selenium exerts a marked protective effect against the toxic action of elements such as mercury and cadmium (Parizek and Ostadalova, 1967). The use of

Concentration (ppm, dry weight)

Element	Concentration (ppm, dry weight)									
	Nymphs		Poliwogs		Newts		Bullhead liver*		Muskrat liver	
	Control pond	Fly-ash pond	Control pond	Fly-ash pond	Control pond	Fly-ash pond	Control pond	Fly-ash pond	Control pond	Fly-ash pond
Aluminum	179	1,373	9,211	20,980	562	524	20	55	11.5	19
Arsenic	0.8	..	..	..	0.8	0.6	0.0	0.4	0.0	0.0
Gold	..	..	..	..	..	..	..	..	..	..
Boron	7.5	..	..	..	1.5	0.6	0.8	0.6	1.9	1.7
Barium	..	..	..	..	..	..	..	..	..	..
Bromine	83	30	38	21	14	24	98	56	5.6	13.2
Calcium	900	979	13,240	10,340	51,200	34,300	400	750	90	336
Cerium	0.4	6.8	16	69	1.7	0.6	3.4	1.7	1.6	2.4
Chlorine	9,900	7,908	8,487	5,470	5,071	3,824	9,320	10,450	2,400	3,140
Cobalt	1.0	2.1	3.7	13	1.2	2.2	1.7	1.2	0.6	0.8
Chromium	1.3	1.9	17	25	6.3	2.5	1.0	3.3	2.5	1.8
Cesium	0.2	0.2	0.5	1.7	0.6	0.2	0.5	0.5	0.2	0.9
Copper	34	86	..	..	..	..	..	..	16	..
Europium	0.4	0.1	0.2	0.9	0.1	0.2	0.3	0.4	..	..
Iron	297	2,646	890	15,800	866	1,135	405	4,594	386	793
Hafnium	0.1	0.1	0.9	..	0.5	..	0.3	..	0.1	0.1
Mercury	0.3	0.2	0.3	0.4	0.3	0.7	1.4	2.1	0.2	0.1
Iodine	2.6	2.2	2.6	25	2.7	3.0	3.1	2.0	0.7	0.4
Potassium	9,222	7,180	14,510	16,140	9,444	9,295	10,020	13,970	8,370	9,195
Lanthanum	0.1	1.5	5.3	23	0.3	0.7	0.2	0.4	0.1	0.1
Lutecium	0.03	0.1	0.1	0.5	0.03	0.1	0.03	0.1	0.02	0.04
Magnesium	500	1,400	4,260	776	1,357	972	240	930	613	720
Manganese	25	24	799	329	63	36	1.8	5.2	9.5	8.7
Molybdenum	0.4	2.2	3.5	6,597	3.4	3.6	..	5.0	2.1	2.8
Sodium	7,122	6,196	9,448	..	4,054	3,771	6,595	8,332	2,523	2,505

Rubidium	14	..	43	48	12	15	11	11	33	13
Antimony	0.4	0.4	1.5	0.6	1.4	0.5	1.2	0.3	0.8	0.3
Scandium	0.01	0.5	1.3	3.5	0.1	0.1	0.02	0.03	..	0.0
Samarium	0.05	1.7	5.6	21	0.4	0.6	0.04	0.1	0.03	..
Strontium	..	..	763	1,720	..	92	123	..	..	..
Tantalum	..	0.2	..	0.3	0.3	..	..	..	0.2	0.3
Thorium	0.4	0.8	3.3	9.2	1.7	1.2	1.1	..	0.4	0.2
Titanium	11	116	369	643	33	11	11	19	7.9	15
Uranium	0.1	0.5	0.9	1.8	0.5	0.2	0.2	..	0.2	0.2
Vanadium	0.6	2.0	15	36	1.2	1.1	0.4	1.4	..	0.1
Tungsten	0.3	..	0.9	0.5	0.6	1.4	1.2	0.6	0.4	0.3
Ytterbium	0.1	0.2	0.6	1.7	0.8	..	0.3	0.1	..	0.1
Zinc	139	158	166	105	235	171	264	211	148	109

* Adult fish, 12 inches long.

TABLE 3. CONCENTRATION OF SELENIUM IN AQUATIC SAMPLES FROM PONDS

Type of sample	Concentration (ppm, dry weight)	
	Control pond	Fly-ash pond
Bottom sediment	0.9	14
Water	0.15	0.35
Pondweeds	0.3	3.7
Algae	0.6	0.9
Nymphs*	1.5	4.1
Polliwogs*	1.5	4.7
Newts*	1.8	4.2
Bullhead (2 inches): flesh	0.7	5.2
Bullhead (5 inches): flesh	0.7	3.4
Bullhead (9 inches): flesh	0.7	1.9
liver	4.4	9.2
Bullhead (12 inches): flesh	1.0	1.7
liver	5.0	8.2
Muskrat: liver	1.0 - 1.3§	2.3 - 2.8†
kidney	3.8 - 4.0§	4.5 - 4.9†

* Entire organism analyzed.

§ Two animals.

† Three animals.

fly ash for removing phosphate from natural waters has been studied (Higgins et al., 1976; Fine and Jensen, 1976). This practice could result in contamination of aquatic species by elements as reported in this study.

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WEIGHTS OF WHITE-TAILED DEER IN RELATION TO RANGE CONDITIONS IN NEW YORK¹

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ABSTRACT

Dressed weights of 5,276 white-tailed deer killed by hunters in New York from 1945 to 1958 were analyzed in relation to the range from which they came for five regions of the State and four special areas. Differences in average weight for deer of the same sex and comparable age from these regions and areas were found to correspond, in general, to differences in the quality of the range. The data indicate that weight, in conjunction with population composition, may be a good index to the status of a deer population in relation to the carrying capacity of the range it occupies.

The weight of a deer is strongly affected by the quantity and quality of the food available to it on the range it occupies. Much research has been done in this field. To cite a few of the published studies: Johnson (1937) found physical deterioration of deer to be related to food shortage; Park and Day (1942) showed that the annual variation in December weights of female deer reflects food conditions better than that of males of the same year class; Sweet and Wright (1952) found that northern New Jersey, with higher soil fertility and better food quality, produced heavier deer than southern New Jersey; and in a similar study Severinghaus (1955) found that weight varied with range conditions in New York. An expansion of the latter study was undertaken to determine whether there are significant differences between the weights of white-tailed deer (*Odocoileus virginianus*) in the five major regions of the State, to determine whether weights from certain areas of poorer range differ significantly from those from the surrounding region as a whole, and to determine whether the weights of deer suffering for the first time from starvation drop in the year or two after the starvation occurred.

For this study, the five regions described by Cheatum and Severinghaus (1950) were considered to represent major differences in range conditions (Figure 1). The Western Region afforded the best deer range; the Peripheral Catskills, Central Catskills and Peripheral Adirondacks were intermediate; and the Central Adirondacks was the

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² Retired.

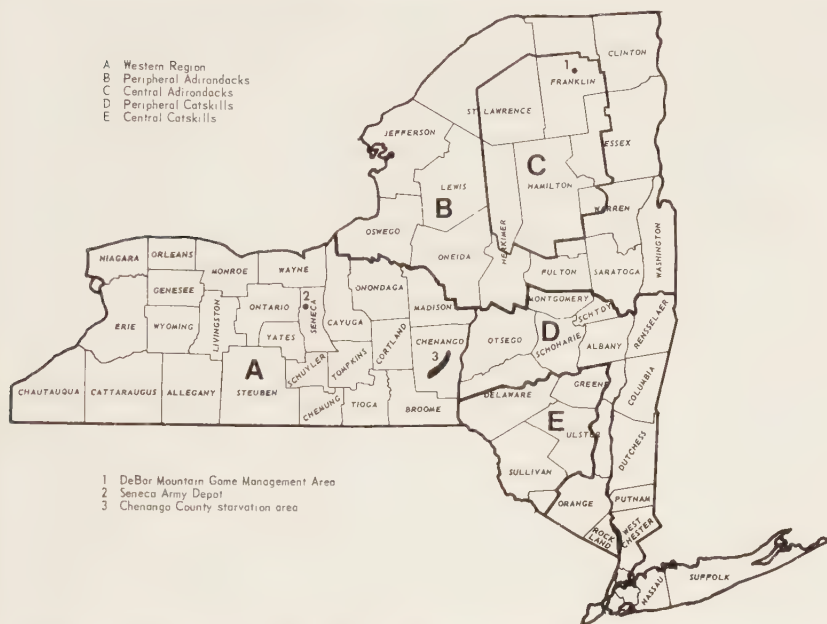


Figure 1. Location of the five major regions of deer range in New York and of the three special study areas.

poorest. In addition, three special areas were selected because of unusual conditions that might affect the weight of deer. Following are descriptions of the latter.

Chenango and Broome Counties are in south-central New York within the western Region. In March 1956 substantial deer mortality occurred in an area of about 20 square miles on the western side of the Chenango River between Greene and Norwich in south-central Chenango County. The area is characterized by steep south- and south-east-facing slopes. Deer that winter there spread out during the summer and fall over some 300 square miles chiefly in Chenango and Broome Counties. Much of this territory was once farming country, but now [1959] at least half of it has reverted to brushland or young forest 20 to 50 years old, although dairy farms are scattered throughout. To facilitate analysis, the starvation area was considered as the entirety of the townships in which it was situated. Deer weights for this area and those for the rest of Chenango and Broome Counties were analyzed separately.

The Seneca Army Depot in northern Seneca County comprises about 9,900 acres of flat land surrounded by a 7-foot fence. Prior to Government purchase in 1942, most of the land was in cultivation, with 10 to 20 per cent in woodland. Following the cessation of farming, the

fields quickly reverted to wild annual and perennial grasses, herbs and forbs. Deer have prevented the growth of virtually all woody plants except for a few of very low palatability.

The DeBar Mountain Game Management Area in the central part of Franklin County in the northern Adirondacks comprises about 13.1 square miles of State-owned land, east, southeast and south of which are blocks of privately owned lands of comparable size. Virtually all this land is heavily forested and mountainous. The lowlands are covered with spruce or balsam, while the higher ground supports northern hardwoods. The winter deer range, depending on the severity of the season, varies between 15 and 25 per cent of the area. From 1928 to 1945 the area was a State game refuge. Between 1948 and 1954, both conifers and hardwoods were cut on the adjacent private land. During the years covered by this study, a major portion of both the winter and summer range of the deer population of the management area was on this private land. On the State land, the blowdown of 1950 and subsequent windfalls opened some of the crown on the wintering area, permitting an increase in the food supply. As a result of these two factors, the food supply available throughout the year and especially in the winter was increased greatly.

METHODS

Dressed weights were analyzed for 3,454 male deer and 1,822 females. Of males, 464 were fawns and 2,990 adults. The female group was composed of 434 fawns and 1,388 adults. The data represent deer taken during the legal open seasons from 1945 to 1958. The weights were recorded at deer checking stations, hunting camps, private homes and commercial freeze lockers. The checking stations were set up to collect other data, and weights were taken only when time permitted.

Special efforts were made to obtain weights for deer taken during the open season for antlerless deer on two wilderness areas in the Adirondacks in 1954 (Severinghaus, 1955), as well as for deer taken on the Howland Island Game Management Area in 1950 and from 1955 to 1958 and on the Montezuma National Wildlife Refuge in 1956 and 1957. These data are included with those for the corresponding regions of the State.

Weights were analyzed separately for deer taken on the Seneca Army Depot in 1957 and 1958, on the DeBar Mountain Game Refuge in 1952 and from 1955 to 1958, and in Chenango and Broome Counties in 1955 and 1956. The data for the latter area are reported separately for the starvation and non-starvation areas.

Age was determined according to the criteria described by Severinghaus (1949).

It is believed that the deer weights recorded represented random samples for each age group. It is recognized, however, that a random sample of the population as a whole was not obtained, because as many weights as possible were secured from deer 2½ years old or older, especially those 5½ years old or older. Since time available for weighing was limited, this selection of the older, less numerous deer was attempted in order to get a large enough sample of these age groups. Adequate samples would enable the average weight for a population to be derived from the mean weight for each age group and the age composition of the population if the latter were known.

FINDINGS

The mean weights for male fawns, yearlings and 2½ year olds from the several regions and areas are summarized and compared in Table 1. Not only are these age groups the ones most consistently represented in the records for all the regions, but they best reflect forage conditions. This analysis is confined to males because, since antlerless deer had not been legal game as often as antlered deer, the majority of the samples for females were too small to be tested. The significance of weight differences was determined by the standard error of difference between the means and was assessed at the 5 per cent level of confidence.

In Table 1 the regions of the State are shown in generally descending order of the mean weights recorded, and the special areas are shown similarly. Deer from the Western Region as a whole averaged heaviest, while those from the Central Adirondacks were lightest. Weights for the Chenango County starvation area averaged less than those for the rest of Chenango and Broome Counties. However, weights for the DeBar Mountain Game Management Area averaged higher than those for the Central Adirondacks as a whole.

The data are presented more fully under each of the five regions. The information for each of the three special areas is reported separately under the region in which it is located.

WESTERN REGION

Average weights of deer from western New York (Table 2) were generally higher than those from other parts of the State for comparable age groups. This was true for both sexes.

Weights of deer from the Chenango-Broome County non-starvation area (Table 3) averaged lower than those for the region as a whole, the difference being significant for yearling males (Table 1). Although the data indicated a similar relationship for males of other ages and for females, the samples were too small for valid comparison.

TABLE 1. MEAN WEIGHTS FOR MALE DEER OF THREE AGE GROUPS IN DIFFERENT AREAS OF NEW YORK AND SIGNIFICANCE OF DIFFERENCES

Area	Age group					
	Fawn (1/2 year)		Yearling (1 1/2 years)		2 1/2 years	
	Mean weight (pounds)*	Significance§	Mean weight (pounds)*	Significance§	Mean weight (pounds)*	Significance§
Region						
Western Region	74.1 ± 8.5	..	118.7 ± 14.1	..	147.2 ± 19.1	..
Peripheral Adirondacks	..	..	109.0 ± 16.2	3.33	142.4 ± 23.0	0.96
Peripheral Catskills	69.5 ± 20.5	..	105.4 ± 25.5	1.00	130.0 ± 35.1	1.91
Central Catskills	54.6 ± 16.3	2.33	95.7 ± 15.6	3.83	113.0 ± 23.9	2.68
Central Adirondacks	53.6 ± 8.1	0.94	91.1 ± 15.9	2.88	122.7 ± 22.2	3.24
Special areas						
Western Region						
Chenango-Broome County non-starvation area	63.7 ± 10.3	3.18†	113.6 ± 12.5	2.49	142.5 ± 17.4	0.98†
Chenango County starvation area	58.6 ± 8.4	9.81	110.2 ± 11.4	5.12	136.0 ± 19.3	2.05†
Seneca Army Depot	61.0 ± 7.5	9.04	94.9 ± 10.8	16.45	120.1 ± 15.8	8.36
Central Adirondacks						
DeBar Mountain Game Management Area	56.1 ± 4.9	1.44†	103.0 ± 17.6	4.23	140.1 ± 19.6	7.16

* Variation shown as standard deviation.

§ P = 1.96 at 5 per cent level. In upper part of table, values represent comparison with region immediately above in each case; in lower part, values represent comparison with region in which special area lies.

† Value represents sample of less than 25 and should be viewed with caution.

TABLE 2. DRESSED WEIGHTS OF DEER TAKEN IN THE WESTERN REGION, 1946-1955

Age	Male				Female			
	Weight			Number	Weight			
	Minimum	Maximum	Average		Minimum	Maximum	Average	
Fawns								
Under 5 months 5-6 months Over 6 months	37	53	87	70.5 ± 8.8	27	55	91	67.1 ± 8.8
	50	62	90	74.5 ± 7.0	53	53	106	70.5 ± 9.0
	42	57	95	76.7 ± 9.0	44	51	87	71.6 ± 9.0
Total fawns	129	53	95	74.1 ± 8.5	124	51	106	70.2 ± 9.0
Adults								
Yearlings 1 year 5 months or less 1 year 6 months 1 year 7 months or more	50	81	136	114.1 ± 12.4	26	73	134	102.9 ± 15.7
	68	90	150	118.3 ± 13.2	26	82	137	109.5 ± 13.5
	93	85	186	121.5 ± 14.9	35	78	129	110.6 ± 12.0
	211	81	186	118.7 ± 14.1	87	73	137	108.0 ± 13.9
Other (years) 2½ 3½ 4½ 5½ 6½ 7½ 8½ 9½ 10½	69	112	203	147.2 ± 19.1	58	89	145	113.6 ± 9.4
	46	110	205	163.4 ± 21.4	41	88	149	114.7 ± 12.9
	16	117	215	176.6 ± 15.7	11	99	156	121.1 ± 16.2
	9	145	240	184.6 ± 26.0	18	100	134	118.8 ± 10.0
	3	155	164	159.7 ± 4.5	4	100	136	115.7 ± 16.2
	0	..	..	..	1	..	..	137.0
	0	..	..	..	3	116	132	122.0 ± 8.7
	0	..	..	..	1	..	..	121.0
	0	..	..	..	3	86	123	108.7 ± 19.9
	143	110	240	158.3 ± 27.7	140	86	156	115.5 ± 11.8
Sub-total	143	110	240	158.3 ± 27.7	140	86	156	115.5 ± 11.8
Total adults	354	81	240	134.7 ± 28.4	227	73	156	112.6 ± 13.1

TABLE 3. DRESSED WEIGHTS OF DEER TAKEN ON THE CHENANGO-BROOME COUNTY NON-STARVATION AREA, 1955-1958

Age	Male				Female			
	Number	Weight		Average	Number	Weight		Average
		Minimum	Maximum			Minimum	Maximum	
Fawns								
Under 5 months	1	..	..	58.0	0	..	..	..
5-6 months	0	..	..	..	1	..	..	47.0
Over 6 months	9	54	69	64.3 ± 10.3	7	39	67	54.1 ± 9.7
Total fawns	10	54	69	63.7 ± 10.3	8	39	67	53.2 ± 9.3
Adults								
Yearlings	14	80	134	109.4 ± 14.3	2	91	112	101.3 ± 15.2
1 year 5 months or less	12	90	125	111.3 ± 11.5	3	92	106	97.3 ± 7.6
1 year 6 months	22	90	141	117.6 ± 11.0	5	93	107	103.6 ± 6.2
1 year 7 months or more								
Sub-total	48	80	141	113.6 ± 12.5	10	91	112	101.3 ± 8.0
Other (years)	17	95	165	142.5 ± 17.4	13	89	121	101.9 ± 9.4
2½	10	129	189	156.9 ± 20.0	6	94	147	113.2 ± 19.4
3½	1	..	..	170.0	2	110	126	118.0 ± 11.3
4½	2	183	192	187.3 ± 6.7	2	99	126	112.3 ± 19.4
5½	0	..	..	..	1	..	..	98.0
6½	1	..	..	203.0	0	..	..	..
7½	1	..	..	221.0	0	..	..	..
8½	0	..	..	..	0	..	..	..
9½	0	..	..	..	0	..	..	..
10½	0	..	..	..	0	..	..	..
Sub-total	32	95	221	155.0 ± 25.6	24	89	147	106.8 ± 13.8
Total adults	80	80	221	131.0 ± 27.7	34	89	147	105.2 ± 12.5

TABLE 4. DRESSED WEIGHTS OF DEER TAKEN ON THE CHENANGO COUNTY STARVATION AREA, 1956-1958

Age	Male				Female			
	Number	Weight		Average	Number	Weight		Average
		Minimum	Maximum			Minimum	Maximum	
Fawns								
Under 5 months 5-6 months Over 6 months	7	35	72	54.1 ± 12.5	8	44	63	50.5 ± 8.7
	3	65	75	68.7 ± 5.5	6	51	62	55.3 ± 4.3
	26	53	78	63.7 ± 5.8	26	48	81	60.0 ± 7.6
Total fawns	36	35	78	58.6 ± 8.4	40	44	81	57.4 ± 8.2
Adults								
Yearlings 1 year 5 months or less 1 year 6 months 1 year 7 months or more	22	77	133	108.1 ± 14.4	12	86	111	94.1 ± 8.4
	24	88	136	108.7 ± 11.8	12	80	107	92.8 ± 8.6
	27	95	129	113.0 ± 10.5	23	83	125	96.6 ± 12.1
	73	77	136	110.2 ± 11.4	47	80	125	94.9 ± 10.3
Other (years) 2 1/2 3 1/2 4 1/2 5 1/2 6 1/2 7 1/2 8 1/2 9 1/2 10 1/2	15	84	163	136.0 ± 19.3	35	86	125	107.9 ± 10.0
	8	122	145	133.9 ± 7.8	17	89	127	112.1 ± 13.4
	2	145	180	162.5 ± 24.7	17	101	143	112.7 ± 13.0
	0	..	..	..	6	106	118	111.4 ± 5.8
	0	..	..	..	5	105	125	115.7 ± 8.6
	0	..	..	..	0	..	..	..
	0	..	..	..	1	..	..	108.0
	0	..	..	..	1	..	..	106.0
	0	..	..	..	1	..	..	125.0
	0	..	..	..	1	..	..	..
Sub-total	25	84	180	137.4 ± 17.9	83	86	143	110.7 ± 11.2
Total adults	98	77	180	117.2 ± 17.8	130	80	143	105.0 ± 13.2

TABLE 5. DRESSED WEIGHTS OF DEER TAKEN ON THE SENECA ARMY DEPOT, 1957-1958

Age	Male				Female			
	Number	Weight		Average	Number	Weight		Average
		Minimum	Maximum			Minimum	Maximum	
Fawns								
Under 5 months	16	50	70	59.4 ± 6.4	12	43	57	52.4 ± 4.8
5-6 months	16	50	82	61.2 ± 8.5	8	49	66	57.2 ± 5.1
Over 6 months	4	61	72	66.2 ± 6.1	2	52	63	57.5 ± 7.7
Total fawns	36	50	82	61.0 ± 7.5	22	43	66	54.6 ± 5.5
Adults								
Yearlings	40	72	130	92.6 ± 11.6	8	43	66	89.2 ± 9.2
1 year 5 months or less	34	74	112	94.3 ± 9.8	5	74	101	91.4 ± 11.0
1 year 6 months	29	82	119	98.9 ± 9.9	15	70	104	91.5 ± 10.0
1 year 7 months								
Sub-total	103	72	130	94.9 ± 10.8	28	43	104	90.8 ± 9.6
Other (years)								
2½	48	81	147	120.1 ± 15.8	40	81	127	101.7 ± 11.4
3½	37	104	173	133.0 ± 18.2	35	89	125	104.6 ± 10.0
4½	27	111	177	153.4 ± 19.3	15	95	123	108.9 ± 9.8
5½	14	128	177	150.7 ± 14.5	19	79	133	110.4 ± 15.1
6½	6	142	172	159.9 ± 10.2	10	90	128	109.9 ± 11.6
7½	1	..	..	188.0	3	100	119	111.0 ± 9.8
8½	0	..	..	..	1	..	..	143.0
9½	0	..	..	..	2	113	114	113.5 ± 0.7
10½	2	181	185	183.0 ± 2.8	2	118	119	118.5 ± 0.7
Sub-total	135	81	185	136.7 ± 23.0	127	81	143	106.3 ± 12.1
Total adults	238	72	185	118.6 ± 27.9	155	43	143	103.5 ± 13.1

TABLE 6. DRESSED WEIGHTS OF DEER TAKEN IN THE PERIPHERAL ADIRONDACKS, 1945-1958

Age	Male				Female			
	Number	Weight		Average	Number	Weight		Average
		Minimum	Maximum			Minimum	Maximum	
Fawns								
Under 5 months	0	..	..	..	0	..	..	..
5-6 months	0	..	..	..	0	..	..	..
Over 6 months	2	57	70	63.5 ± 9.2	0	..	..	..
Total fawns	2	57	70	63.5 ± 9.2	0	..	..	..
Adults								
Yearlings	10	90	142	107.3 ± 19.4	0	..	..	..
1 year 5 months or less	5	106	129	115.4 ± 10.1	0	..	..	..
1 year 6 months	7	88	130	111.7 ± 16.5	0	..	..	..
1 year 7 months or more	13	82	130	106.3 ± 16.0	0	..	..	..
Age in months not known	35	82	142	109.0 ± 16.2	0	..	..	..
Sub-total								
Other (years)	39	96	198	142.4 ± 23.0	1	..	..	102.0
2½	35	125	220	163.8 ± 23.4	0	..	..	..
3½	23	134	238	193.2 ± 23.5	0	..	..	..
4½	11	125	213	177.9 ± 28.0	0	..	..	..
5½	6	150	204	172.8 ± 18.5	0	..	..	..
6½	2	159	185	172.0 ± 18.4	0	..	..	..
7½	5	160	202	187.7 ± 17.1	0	..	..	..
8½ and 9½	1	..	..	220.0	0	..	..	..
10½								
Sub-total	122	96	238	165.8 ± 29.9	1	..	..	102.0
Total adults	157	82	238	153.1 ± 36.2	1	..	..	102.0

TABLE 8. DRESSED WEIGHTS OF DEER TAKEN IN THE CENTRAL CATSKILLS, 1946-1958

Age	Male				Female			
	Number	Weight		Average	Number	Weight		Average
		Minimum	Maximum			Minimum	Maximum	
Fawns								
Under 5 months 5-6 months Over 6 months	10	34	72	50.9 ± 10.2	8	32	60	45.2 ± 9.2
	17	32	96	53.0 ± 19.4	15	33	60	46.9 ± 9.4
	13	36	103	59.6 ± 15.5	16	36	74	55.1 ± 10.8
Total fawns	40	32	103	54.6 ± 16.3	39	32	74	49.9 ± 10.7
Adults								
Yearlings 1 year 5 months or less 1 year 6 months 1 year 7 months or more Age in months not known	42	61	122	89.4 ± 13.3	4	63	100	75.2 ± 16.8
	49	54	125	94.8 ± 15.8	16	74	98	87.5 ± 9.3
	45	75	150	102.2 ± 15.0	7	66	106	85.4 ± 13.5
	1	..	..	115.0	0	..	..	..
	137	54	150	95.7 ± 15.6	27	63	106	85.1 ± 12.0
Other (years) 2½ 3½ 4½ 5½ 6½ 7½ 8½ 9½ 10½	77	56	175	113.0 ± 23.9	22	74	124	99.7 ± 13.1
	52	80	218	141.5 ± 31.6	18	80	140	99.9 ± 16.5
	20	102	210	152.0 ± 29.7	6	96	127	113.0 ± 13.1
	4	133	198	163.8 ± 30.4	3	86	110	98.7 ± 12.1
	1	..	..	143	0	..	..	..
	2	111	150	130.5 ± 27.6	2	78	108	93.0 ± 21.2
	0	..	..	..	2	72	106	89.0 ± 24.0
	0	..	..	..	3	70	120	90.0 ± 26.5
	0	..	..	..	0	..	..	..
Sub-total	156	56	218	129.2 ± 33.4	56	70	140	100.0 ± 15.6
Total adults	293	54	218	113.6 ± 30.6	83	63	140	95.2 ± 16.1

TABLE 9. DRESSED WEIGHTS OF DEER TAKEN IN THE CENTRAL ADIRONDACKS, 1945-1958

Age	Male				Female			
	Number	Weight			Number	Weight		
		Minimum	Maximum	Average		Minimum	Maximum	Average
Fawns								
Under 5 months	107	38	68	52.2 ± 8.5	106	30	67	49.4 ± 7.8
5-6 months	58	40	70	54.5 ± 6.9	53	40	74	53.0 ± 7.5
Over 6 months	21	42	75	57.7 ± 7.7	16	46	76	58.9 ± 10.8
Total fawns	186	38	75	53.6 ± 8.1	175	30	76	51.3 ± 8.5
Adults								
Yearlings	163	52	136	89.6 ± 15.7	80	50	114	78.0 ± 11.8
1 year 5 months or less	80	58	130	88.3 ± 13.9	41	63	110	76.5 ± 10.0
1 year 6 months	44	70	140	95.4 ± 15.7	26	60	110	86.9 ± 13.7
1 year 7 months or more	37	70	150	98.3 ± 18.5	0	..	..	..
Age in months not known								
Sub-total	324	52	150	91.1 ± 15.9	147	50	114	79.1 ± 12.2
Other (years)	313	78	200	122.7 ± 22.2	132	60	162	91.2 ± 14.3
2½	261	94	247	145.3 ± 25.9	180	64	134	93.3 ± 13.3
3½	159	108	212	159.3 ± 22.8	71	72	170	96.0 ± 12.9
4½	77	115	218	158.4 ± 23.9	45	62	140	94.5 ± 17.0
5½	53	95	237	160.7 ± 24.9	34	77	122	95.5 ± 12.0
6½	33	110	221	161.3 ± 25.6	32	69	125	93.9 ± 13.0
7½	15	94	194	159.4 ± 26.3	35	70	120	91.1 ± 11.0
8½ and 9½	3	125	191	154.0 ± 33.7	14	85	138	98.4 ± 13.5
10½								
Sub-total	914	78	247	142.8 ± 28.5	543	60	170	93.4 ± 13.7
Total adults	1,238	52	247	129.3 ± 34.4	690	50	170	90.4 ± 14.6

TABLE 10. DRESSED WEIGHTS OF DEER TAKEN ON THE DEBAR MOUNTAIN GAME MANAGEMENT AREA, 1952-1958

Age	Male				Female			
	Number	Weight		Average	Number	Weight		Average
		Minimum	Maximum			Minimum	Maximum	
Fawns								
Under 5 months 5-6 months Over 6 months	2	45	62	53.5 ± 12.0	3	54	62	57.7 ± 4.1
	0	..	..	..	3	56	59	57.7 ± 1.6
	7	55	61	56.9 ± 2.1	8	49	59	53.9 ± 3.2
Total fawns	9	45	62	56.1 ± 4.9	14	49	62	55.5 ± 3.5
Adults								
Yearlings 1 year 5 months or less 1 year 6 months 1 year 7 months or more	25	86	122	103.7 ± 22.3	1	..	..	81.0
	16	88	114	97.6 ± 6.9	1	..	..	85.0
	20	82	156	106.6 ± 16.5	2	79	94	86.5 ± 10.6
	61	82	156	103.0 ± 17.6	4	79	94	84.8 ± 6.7
Other (years) 2½ 3½ 4½ 5½ 6½ 7½ 8½ and 9½ 10½	88	95	207	140.1 ± 19.6	9	90	125	105.7 ± 9.9
	74	123	213	162.1 ± 22.0	4	98	115	106.2 ± 7.0
	36	130	216	186.2 ± 21.0	5	94	130	106.2 ± 13.9
	13	149	206	182.7 ± 18.8	1	..	..	117.0
	9	163	201	187.1 ± 11.7	1	..	..	131.0
	12	148	229	193.7 ± 22.3	0	..	..	..
	6	160	200	182.2 ± 14.4	3	103	124	111.5 ± 10.7
	1	..	..	151.0	0	..	..	..
	239	95	229	161.7 ± 27.9	23	90	131	108.2 ± 11.0
	300	82	229	149.8 ± 35.3	27	79	131	104.8 ± 8.4

Weights of deer from the Chenango County starvation area (Table 4) were lower, in general, than those from elsewhere in Chenango and Broome Counties. The male fawns, yearlings and $2\frac{1}{2}$ year olds were significantly lighter than those from the non-starvation area (Table 1), but the number of $2\frac{1}{2}$ year olds was small. For females, weights for the starvation area were lower than those for the Western Region as a whole, but a valid comparison with the non-starvation area cannot be made because of the small number of records from the latter.

Average weights for deer from the Seneca Army Depot (Table 5) were the lowest in western New York, being very significantly lower for male fawns, yearlings and $2\frac{1}{2}$ year olds (Table 1) although the male fawns from the Depot were slightly heavier than those from the Chenango County starvation area. Weights of female deer from the Depot also averaged less than those of females from the region as a whole, but the differences were not as great.

PERIPHERAL ADIRONDACKS

The data for this region are given in Table 6. There were virtually no records for fawns of either sex or for females. The weights of yearling males averaged significantly lower than those from western New York (Table 1), while weights for older males were comparable. Although the over-all sample was insufficient for definite conclusions, deer from this region may be slightly smaller than those of western New York.

PERIPHERAL CATSKILLS

The data for this region are given in Table 7. Weights for both males and females were lower than those from western New York. The difference was significant for male fawns, yearlings and $2\frac{1}{2}$ year olds (Table 1). Weights of male yearlings and $2\frac{1}{2}$ year olds from this region were lower than those from the Adirondacks, but the difference was not significant.

CENTRAL CATSKILLS

Weights of deer, both male and female, from the Central Catskills (Table 8) averaged less than those from the Western Region. Male fawns, yearlings and $2\frac{1}{2}$ year olds were significantly lighter than those of the Peripheral Catskills (Table 1), and there was probably a similar relationship for females but the differences were not significant.

CENTRAL ADIRONDACKS

The data for this region are given in Table 9. For the age groups

shown in Table 1, deer from the Central Adirondacks and those from the Central Catskills had the lowest average weights in the State. However, the relationship between these two regions was not consistent. Weights of both male fawns and yearlings from the Central Adirondacks averaged lower, but the difference was significant only for the yearlings. On the other hand, the 2½ year olds from the Central Adirondacks averaged significantly heavier than those from the Central Catskills. A review of the data for adequate samples suggests that there may be little real difference in average weight between the deer of these two regions.

Weights of deer from the DeBar Mountain Game Management Area (Table 10) averaged consistently higher than those of deer from the Central Adirondacks as a whole (Table 9). For the age groups shown in Table 1, the difference was significant for yearlings and 2½ year olds, but no valid comparison could be made for fawns because the sample from the DeBar area comprised only nine individuals. Weights for the DeBar area averaged slightly higher than those of deer from the Central Catskills.

DISCUSSION

The data demonstrate regional differences in deer weight in New York that reflect relative range quality. The highest weights were found in regions having the best available food supply, especially during the winter. Severinghaus (1955) concluded "adequacy of the food supply during the winter is the critical factor". Certain characteristics of the regions and special areas studied, and aspects of their history, warrant comment.

WESTERN REGION

There is much abandoned farmland in this region. These lands have become overgrown and afford good deer browse. As a result, most of the range is excellent. There is adequate winter food for deer, and they are able to maintain high weights. Enough antlerless deer have been taken periodically in most localities to hold or reduce the winter population to levels which have prevented deterioration of the available food supply. The Chenango-Broome County non-starvation area is within the territory to which these features apply.

CHENANGO COUNTY STARVATION AREA In the highlands around this valley, the winter of 1955-56 was more severe than usual and much starvation occurred. Cheatum (1956) reported that 400 deer, representing approximately 10 per cent of the population, died of starvation in a 22-mile stretch of the Chenango River valley. Severinghaus (1956a) reported that in certain parts of the valley starved deer were

found at the rate of 110 per square mile of wintering area surveyed. These are the highest rates of starvation loss ever recorded in New York State.

In both 1954 and 1955 the legal kill per square mile in Chenango County was the highest in the Western Region, indicating that the area was supporting a very large population and probably was overpopulated. This may have resulted in a food shortage due to overbrowsing. With insufficient food, the deer gradually lost weight until finally, in the severe winter of 1955-56, many fawns died.

Also, data compiled during the present study showed that deer from this area, taken during the fall of 1955 before the starvation winter, weighed considerably less than deer from western New York in general. Although the sample was small, this may have been another indication that there was range deterioration. Weight declined gradually to a point where the deer were not able to withstand a winter more severe than usual without some starvation losses among fawns.

SENECA ARMY DEPOT The deer population on this area, protected from hunting, increased to far over the carrying capacity of the winter range. By the winter of 1953-54, the good quality browse had been almost eliminated, the medium quality browse had been severely damaged by the deer, and the low quality browse had been heavily eaten. Although the average weights appeared to be low, no deer were found dead of starvation. An attempt to reduce the population by live trapping was unsuccessful. The number of deer was estimated at 1,000 in 1954 (Bromley and Severinghaus, 1956) and double that by 1957. There was no starvation, however, until the spring of 1957 (Severinghaus, 1958) and a hunting season that fall did not prevent further starvation in the spring of 1958.

Deer originally enclosed when the area was fenced were typical in weight of those in the Western Region generally. During the late 1940's the deer were considered, from visual appraisal, equal in size to those of the rest of the region. When the weight decrease started is not known. However, it was evident that weights had been very low for at least three winters (beginning with 1954-55) before any fawns died of starvation.

Then, after only one winter with starvation losses, weights for the various age groups were obtained in the fall of 1957. It was found that males, from fawns to 3½ year olds, were from 13 to 30 pounds lighter than males of the same age from the Western Region generally. Females of the same age groups were from 15 to 17 pounds lighter.

PERIPHERAL CATSKILLS AND CENTRAL CATSKILLS

The Catskill deer population has been increasing steadily for some

50 years. The range, especially that part west of the Hudson River, is becoming overbrowsed (Severinghaus, 1956b). The Peripheral Catskills, being more accessible, has a lower abundance of deer, since a higher proportion of the crop is removed annually by all causes, principally hunting. With fewer deer per square mile, more food is available to each deer, and weights average higher than those in the Central Catskills.

PERIPHERAL ADIRONDACKS

The Adirondack deer population has not been increasing during the past 50 years. The condition of the winter range varies from severely overbrowsed to lightly browsed, depending on the population level. In the Peripheral Adirondacks deer abundance has been lower than in the Central Adirondacks, due in part to greater accessibility. Road networks are more extensive and hunters are able to deploy easily to hunt. This factor, along with illegal hunting both during and outside the open season, has prevented any substantial increase (Severinghaus, 1956a; Jackson et al., 1978). As a result, food conditions per deer are better than in the Central Adirondacks. Less starvation occurs and larger deer are produced.

CENTRAL ADIRONDACKS

The problem in the Central Adirondacks is chronic starvation, ranging from severe to negligible (Severinghaus, 1947, 1956b). The wintering range is only 10 to 20 per cent of that occupied during the rest of the year, with concentrations in some areas exceeding 100 deer per square mile. Because of the severe overbrowsing that is common in most wintering areas, the average-sized deer does not obtain adequate nutrition during the winter. The average weights of deer in this region, together with those of deer in the Central Catskills, were the lowest in the State.

On the DeBar Mountain Game Management Area, the relationship of the deer population to the carrying capacity of the winter range was improved by heavy harvests of deer as well as the cut of forest products described earlier. From 1952 to 1958 an average of about eight legal deer per square mile were taken annually. This was more than four times the legal take in Franklin County generally. In addition, illegal killing, averaging about 5.6 deer per square mile annually, helped decrease the population to the point where there was sufficient food for most of the deer remaining after the hunting season.

The combination of increased food supply, heavy legal harvests and heavy illegal kills of deer on the DeBar area has been associated with a

weight differential of from 12 to 27 pounds between male deer 1½ to 4½ years old from that area and males of the same ages elsewhere in the Central Adirondacks. This greater average weight exists even though the palatable winter foods are severely overbrowsed and a few deer still die of starvation each winter. Data for female deer from the DeBar area were too few for valid comparison.

GENERAL RANGE RELATIONSHIPS

From the weight data compiled, certain general range relationships are evident that have a strong bearing on deer management.

1. Where deer populations have been maintained at or below the carrying capacity of the winter range, deer weights remained high. The Western Region was an example of this.
2. Where deer numbers were far above the carrying capacity, deer weights were low. The Central Adirondacks and Central Catskills were examples of this.
3. Where overpopulation in relation to the available winter food occurred, and the population was subsequently reduced to the carrying capacity of the range and logging increased the food supply at least temporarily, deer weights increased. This occurred on the DeBar Mountain Game Management Area.
4. Where, on good range, an overpopulation of deer caused deterioration of the food supply, deer weights decreased. This occurred on the Chenango County starvation area and the Seneca Army Depot.

RELATION OF WEIGHT TO AGE

The data also show that the average weight of deer increased with age (Table 11). Peak weights were reached at about 5½ or possibly 6½ years for males, and at about 4½ or possibly 5½ years for females. In all areas and at all ages, males were heavier than females.

The initial growth of young deer, up to 1½ years old, on range areas of different quality sets the pattern for the relative weights attained as adults (Table 11 and Figure 2). Thus, where starvation is chronic as in the Central Adirondacks (and also the Central Catskills, Chenango County starvation area and Seneca Army Depot), both yearling and older males weighed less than those from the Western Region. This also applied to females from all areas. However, in areas where starvation was not chronic or where an improved relationship between the deer population and its food supply occurred, as on the DeBar

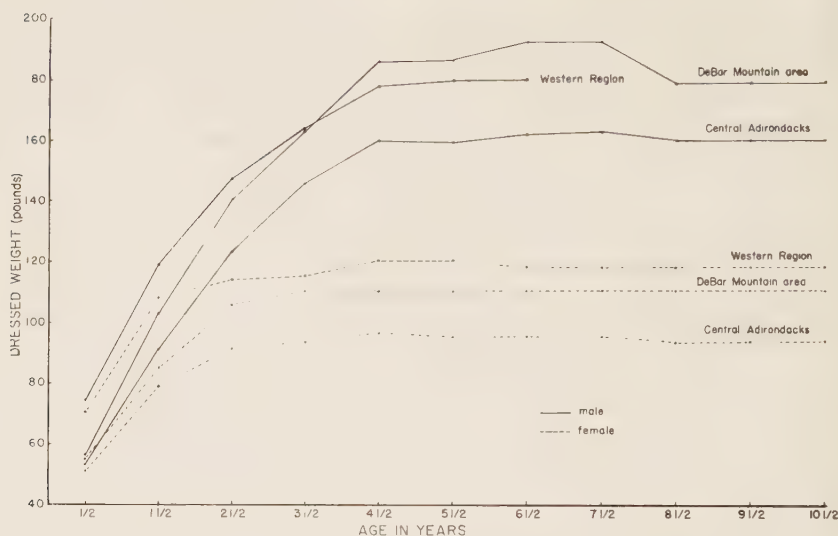


Figure 2. Comparison of average dressed weights at different ages for male and female deer from the Western Region, Central Adirondacks and DeBar Mountain Game Management Area.

Mountain Game Management Area (and also the Peripheral Adirondacks and Chenango-Broome County non-starvation area), males $3\frac{1}{2}$ years old or older attained average weights virtually the same as those for deer of similar ages from the Western Region. For females, average weights for such range were closer to those for the Western Region than to those for the Central Adirondacks, but they did not reach or exceed them.

The apparent inability of older females to attain average weights as high as those of older males may be due to the difference in size, bully dominance and aggressiveness. The older males may be able to obtain the best food by sheer dominance over adult females as well as younger (smaller) deer of both sexes. Instances of such aggressive-submissive patterns have been frequently observed in wintering areas and at feeding stations (Collias, 1950).

RELATION OF WEIGHT TO POPULATION COMPOSITION

To be legal game in New York when only antlered deer may be taken, a deer must have antlers at least 3 inches long. For purposes of this discussion, the term "buck" will be used for males of this sort.

The average weight of bucks from an area is often considered an index to the condition of the deer in that area and, in turn, an index to the condition of the range in relation to the deer population. One

fallacy of this hypothesis is that the frequency of bucks in the different age groups is not considered.

The age-frequency distribution of buck deer taken by hunters from 1954 to 1958 in the Central Adirondacks and in the Western Region is given in Table 12. Differences are evident: (1) in the Central Adirondacks hunters took some old bucks (3.3 per cent were $7\frac{1}{2}$ years old or older) while in the Western Region virtually no bucks of this age (0.1 per cent) were taken; (2) bucks of prime age ($3\frac{1}{2}$ to $6\frac{1}{2}$ years) comprised 42.2 per cent of those taken in the Central Adirondacks but only 10.0 per cent of those taken in the Western Region; (3) yearling bucks comprised only 24.7 per cent of those taken in the Central Adirondacks compared with 74.9 per cent for the Western Region.

In the Central Adirondacks yearlings were less frequent than $2\frac{1}{2}$ year olds while in the Western Region they were much more frequent. Also, the frequency of yearlings varied considerably between years (as much as 12.7 percentage points) in the Central Adirondacks, while it was more stable (difference of only 8.2 percentage points) in the Western Region. This occurs in the Central Adirondacks because a substantial proportion (up to 50 per cent after a severe winter) of the yearlings there do not produce antlers 3 inches or more long. Because these "antlerless" adult males are not legal bucks, the frequency of yearlings taken by hunters is below that of the $2\frac{1}{2}$ year olds and below the actual frequency of yearling males existing in the population afield.

The average weights for the bucks as a whole from these two regions of New York were virtually identical, i.e., 128.6 pounds for the Central Adirondacks and 127.8 pounds for the Western Region. Individuals who hunt deer in both regions usually feel that the Adirondack bucks are larger, and many have difficulty accepting the idea that the range there is poorer than that in the Western Region. The reason for this is quite simple and involves the difference in age composition of the two populations. For the Central Adirondacks, further analysis of the records summarized in Table 9 shows that only a negligible number of the yearling males attained a weight of 145 pounds, whereas about 17 per cent of the $2\frac{1}{2}$ year olds, 50 per cent of the $3\frac{1}{2}$ year olds and 83 per cent of the $4\frac{1}{2}$ -year-old or older males equalled or exceeded that weight. In the Western Region, on the other hand, analysis of the records summarized in Table 2 shows that some 3 per cent of the yearling males, 50 per cent of the $2\frac{1}{2}$ year olds and 83 per cent of the $3\frac{1}{2}$ -year-old or older males weighed 145 pounds or more. In Table 13 these proportions are applied, as an example, to equal populations of 1,000 male deer for the corresponding regions to derive the number in each case that would weigh 145 pounds or more. From this it is evident

TABLE 12. AGE-FREQUENCY DISTRIBUTION OF BUCK DEER TAKEN BY HUNTERS IN THE CENTRAL ADIRONDACKS AND IN THE WESTERN REGION OF NEW YORK, 1954-1958*

Year	Item	Age (years)										Total
		1½	2½	3½	4½	5½	6½	7½	8½ & 9½	10½		
		Central Adirondacks										
1954	Number Per cent	205 26.9	273 35.8	152 20.0	67 8.8	36 4.7	20 2.6	5 0.7	3 0.4	1 0.1	762 100.0	
1955	Number Per cent	177 17.0	363 34.9	247 23.8	135 13.0	68 6.6	21 2.0	15 1.4	10 1.0	3 0.3	1,039 100.0	
1956	Number Per cent	161 19.1	208 24.7	234 27.8	117 13.9	46 5.5	39 4.6	22 2.6	13 1.5	3 0.3	843 100.0	
1957	Number Per cent	296 29.2	243 23.9	213 21.0	106 10.4	55 5.4	53 5.2	23 2.3	21 1.8	5 0.5	1,015 100.0	
1958	Number Per cent	381 29.7	385 30.0	211 16.5	136 10.6	82 6.4	44 3.4	23 1.8	16 0.7	4 0.3	1,282 100.0	
Total	Number Per cent	1,220 24.7	1,472 29.8	1,057 21.4	561 11.4	287 5.8	177 3.6	88 1.8	63 1.2	16 0.3	4,941 100.0	
Average weight	(pounds) §	91.1	122.7	145.3	159.3	158.4	160.7	161.3	158.5		128.6	

Western Region

1954	Number Per cent	292 72.8	52 13.0	41 10.2	14 3.5	1 0.3	1 0.3	..	..	..	401 100.0	
1955	Number Per cent	699 72.1	157 16.2	83 8.5	20 2.1	7 0.7	3 0.3	1 0.1	..	..	970 100.0	
1956	Number Per cent	693 77.4	122 13.6	61 6.8	9 1.0	5 0.6	3 0.4	1 0.1	1 0.1	..	895 100.0	
1957	Number Per cent	234 74.1	61 19.3	19 6.0	2 0.6	..	..	..	..	..	316 100.0	
1958	Number Per cent	248 80.3	41 13.3	15 4.8	5 1.6	..	..	..	..	..	309 100.0	
Total	Number Per cent	2,166 74.9	433 15.0	219 7.6	50 1.7	13 0.5	7 0.2	2 0.1	1 0.0	..	2,891 100.0	
Average weight	(pounds) §	118.7	147.2	163.4	176.6	178.4						127.8

* Age data for the Western Region were recorded from 1956 to 1958, but weights (Table 2) were not.

§ From Table 9 for the Central Adirondacks and from Table 2 for the Western Region.

TABLE 13. RELATIVE NUMBER OF INDIVIDUALS WEIGHING 145 POUNDS OR MORE IN COMPARABLE POPULATIONS OF 1,000 MALE DEER IN THE CENTRAL ADIRONDACKS AND THE WESTERN REGION

Age (years)	Central Adirondacks			Western Region		
	Population§	Individuals weighing 145 pounds or more		Population§	Individuals weighing 145 pounds or more	
		Per cent†	Number		Per cent†	Number
1½	247	0	0	749	3	22
2½	298	17	51	150	50	75
3½	214	50	107			
4½*	241	83	200	101	83	84
Total	1,000	xx	358	1,000	xx	181

* Includes 3½ year olds in Western Region.

§ Age distribution represents total percentages in Table 12.

† Derived from Table 9 for Central Adirondacks and Table 2 for Western Region (see text).

that the chances of encountering such a buck are about 36 in 100 in the Central Adirondacks against about 18 in 100 in the Western Region. The explanation lies in the much greater proportion of the population in the Central Adirondacks that are more than 2½ years old. Nevertheless, the fact that 53 per cent of the 1½ and 2½ year olds in the Western Region weighed 145 pounds or more, compared with only 17 per cent for their counterparts in the Central Adirondacks, is evidence of the better quality of the range there.

The data presented here demonstrate regional differences in the average weights of deer in New York. As with data on antler size (Severinghaus et al., 1950) and the fertility of does (Cheatum and Severinghaus, 1950), the best conditions were found in the Western Region and the poorest in the Central Adirondacks. However, weights from the Central Catskills were virtually the same as those from the Central Adirondacks, while weights from the Peripheral Adirondacks were second to those of the Western Region. The differences correspond, in general, to differences in the quality of the range. The data indicate that weight, in conjunction with population composition, may be a good index to the status of a deer population in relation to the carrying capacity of the range it occupies.

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GENERAL NOTES

REPRODUCTION OF LAKE TROUT IN LAKE GEORGE¹

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Since 1955 when there was a nearly total loss among fry of lake trout from Lake George at the Lake George State Fish Hatchery, the reproduction capabilities of this stock have been studied. The work was expanded in the years 1960 to 1962 to include other lakes in areas of high DDT use in New York, and it was shown that a close relationship existed between DDT concentration in lake trout eggs and the resulting mortality among the fry. These data were published by Burdick et al. (1964) In 1964 the use of DDT was prohibited on lands under control of the State Conservation Department and located in watersheds containing lake trout. The present paper reports on research that has been accomplished since 1962 regarding lake trout reproduction in Lake George.

The fish studied were lake trout (*Salvelinus namaycush*) taken from Lake George in Warren County (N.Y.) or the progeny of such fish hatched and reared at the Lake George hatchery. For some of the experimental work, the eggs and fry from individual females were held separate.

Residues of DDT and related compounds in the flesh and eggs of female lake trout collected in Lake George from 1961 through 1973, together with the mortality among feeding fry from these fish, are compared in Table 1. From these data, the following conclusions can be drawn.

1. DDT levels in adult females decreased over the period of study, but some fish still contained high levels (above the 5.0 ppm actionable level, i.e., maximum set by the U.S. Food and Drug Administration as safe for human consumption) in 1973.
2. The pp'DDT in the total DDT complex also decreased and at the end of the study constituted a small percentage of the total.
3. There was good linear correlation between concentrations of both total DDT ($r = 0.98$) and pp'DDT ($r = 0.95$) in the egg and concentrations of the same organochlorines in the flesh. Only data analyzed by the gas-liquid chromatograph were used for statistical purposes.
4. Larger, older fish had higher levels than smaller, younger fish.

Lake trout collected from Lake George in 1973 and 1974 are compared in Tables 2 and 3 with respect to size. The 1973 collections were made to obtain a representative sample of spawning females to determine whether fry survival rates were acceptable and whether the size of females may be a factor in DDT levels and fry survival. The 1974 data were taken in connection with regular egg taking for propagation purposes.² The similarity of the two groups in size distribution indicates that the fish taken in 1973 were a representative sample.

Table 4 shows the mortality among feeding fry for the experimental lots at the Lake George hatchery in 1973. The data indicate an average loss of 9 per cent. Table 5 shows the mortality among feeding fry for regular production lake trout from

¹ The authors wish to acknowledge the assistance given, over many years, by personnel of the Fish Propagation Unit and by fisheries biologists from Region 5 in the fish collection, hatching and rearing, and record keeping necessary for this study. All chemical analyses were done by personnel at the Rome Pollution Unit Laboratory.

² All 1974 data are from the unpublished progress report (1974) of the Lake George lake trout study by the Fishery Management Unit of Region 5.

TABLE 1. COMPARATIVE RESIDUES OF DDT IN THE FLESH AND EGGS OF FEMALE LAKE TROUT FROM LAKE GEORGE* TOGETHER WITH THE MORTALITY OF FEEDING FRY FROM EACH FISH, DURING THE PERIOD 1961 TO 1973

Length (inches)	Weight (pounds)	Flesh		Eggs		Mortality of feeding fry (per cent)
		Total DDT, DDE and DDD (ppm)	pp'DDT (ppm)	Total DDT, DDE and DDD (ppm)	pp'DDT (ppm)	
1961						
26.0	6.5	86.1	62.1	12.93	9.14	100
24.0	6.5	84.7	64.6	8.52	5.66	100
21.75	3.8	110.3	81.9	20.25	13.98	100
1962						
25.5	6.5	89.6	69.5	19.79	11.88	100
25.5	5.8	138.9	113.7	15.25	13.23	100
23.0	4.9	102.5	76.1	11.05	10.05	100
1968						
30.4	9.0	142.77	60.01	42.05	16.29	99
28.8	7.25	117.84	42.95	36.71	13.33	90
24.5	5.25	41.25	18.81	6.20	0.36	24
1972						
27.6	7.0	32.59	14.96	6.36	1.20	8
23.5	4.2	20.18	8.42	3.09	0.72	13
21.7	2.8	10.29	6.47	5.20	0.74	15
1973						
32.4	11.5	77.44	28.36	18.00	5.89	16
28.1	7.5	62.69	22.58	13.60	6.12	15
27.0	6.9	17.10	4.72	3.09	1.19	6
24.9	4.4	8.19	3.34	2.40	0.88	9
20.2	2.1	7.74	2.42	2.73	1.05	9

* Analyses for DDT in 1961 and 1962 were made by the Schecter-Haller method as modified by Lisk (D. J. Lisk, personal communication), and final solutions were analyzed by a spectrophotometer. Later samples were analyzed by a gas-liquid chromatograph method so that a direct comparison of the data cannot be made.

Lake George at the Lake George hatchery, as taken from the the monthly feeding charts, for various years extending back to 1945 which was before DDT was used extensively as a pesticide in forest areas. In 1945 there was a 12.1 per cent loss of production fry, but by the mid-1950's losses were high, attributable to DDT. Then, by the early 1970's, following the prohibition of DDT use in 1966, production losses had fallen to about their original level.

Table 6 shows the losses among fry from female lake trout used for brood stock that were brought in as eggs from Lake George fish and held at the hatchery for their entire lives. They were not exposed to any DDT as were the "wild" fish, although they were crossed with males from Saranac Lake. The average loss for the four years included was 11.9 per cent.

On the basis of these data, it appears that, for fry of lake trout from Lake George at the Lake George hatchery, losses of from 5 to 15 per cent during the critical swim-up period may be considered normal. Therefore, the 1973 loss of 9 per cent in the experimental lots and the 1974 loss of 10.1 per cent among production fish can be considered within normal and acceptable limits.

TABLE 2. SIZE DISTRIBUTION OF RIPE FEMALE LAKE TROUT COLLECTED FROM LAKE GEORGE IN 1973 AND 1974

Length (inches)	1973		1974	
	Number	Per cent	Number	Per cent
18.0 - 18.9	0	..	4	2.61
19.0 - 19.9	1	7.14	12	7.84
20.0 - 20.9	2	14.29	8	5.23
21.0 - 21.9	0	..	5	3.27
22.0 - 22.9	0	..	2	1.31
23.0 - 23.9	0	..	0	..
24.0 - 24.9	1	7.14	5	3.27
25.0 - 25.9	2	14.29	8	5.23
26.0 - 26.9	0	..	24	15.69
27.0 - 27.9	4	28.57	21	13.73
28.0 - 28.9	3	21.43	26	16.99
29.0 - 29.9	0	..	20	13.07
30.0 - 30.9	0	..	13	8.50
31.0 - 31.9	0	..	4	2.61
32.0 - 32.9	1	7.14	1	0.65
Total	14	100.00	153	100.0

TABLE 3. PERCENTAGE DISTRIBUTION, ACCORDING TO THREE SIZE CATEGORIES, OF RIPE FEMALE LAKE TROUT COLLECTED FROM LAKE GEORGE IN 1973 AND 1974

Size category		1973	1974
Small (18.0 - 23.9 inches)		21.4	20.3
Medium (24.0 - 29.9 inches)		71.4	67.9
Large (30.0 - 32.9 inches)		7.1	11.7

TABLE 4. MORTALITY AMONG FEEDING FRY FOR EXPERIMENTAL LOTS OF LAKE GEORGE STRAIN LAKE TROUT AT THE LAKE GEORGE HATCHERY IN 1973

Lot number	Number of fry	Mortality	
		Number	Per cent
6R6008	417	19	5
6R5188	409	62	15
6R6035	376	56	15
6R6049	319	17	5
6R6050	419	27	6
6R6051	368	20	5
6R5190	421	40	10
6R8352	298	32	11
6R5192	267	25	9
6R5191	354	20	6
6R8357	391	17	4
6R8361	398	49	12
6R5920	291	47	16
6R8366	397	26	7
Total	5,125	457	9

TABLE 5. MORTALITY AMONG FEEDING FRY FOR REGULAR PRODUCTION LAKE GEORGE, STRAIN LAKE TROUT AT THE LAKE GEORGE HATCHERY

Year	Number of fry	Mortality	
		Number	Per cent
1945	223,000	27,000	12.1
1955	283,000	268,000	94.0
1972	152,000	26,000	17.1
1973	140,000	8,000	5.7
1974	118,000	12,000	10.1

TABLE 6. MORTALITY AMONG FEEDING FRY FOR REGULAR PRODUCTION LAKE GEORGE, STRAIN LAKE TROUT AT THE LAKE GEORGE HATCHERY*

Year	Number of fry	Mortality	
		Number	Per cent
1966	63,000	9,000	14.2
1967	60,000	8,000	13.3
1968	28,000	3,000	10.7
1969	42,000	3,000	7.1
Total	193,000	23,000	11.9

* These were from hatchery female brood stock crossed with males from Saranac Lake (see text).

The data indicate the following conclusions concerning lake trout in Lake George, in terms of the end of this study (1974).

1. DDT levels in females are still high, especially in older, larger fish.
2. Although there was good correlation between DDT levels in the eggs and flesh of the same fish, the former is likely to be the better estimation of potential reproductive problems. Concentrations of contaminants in the eggs may be the causal factor of reproductive failure and can be measured directly.
3. Stripping large lake trout (over 30 inches long) for propagation purposes increases the probability of having a higher average loss among feeding fry attributable to the DDT syndrome. If these large fish do not make up more than 10 per cent of the total and if the size distribution of the remaining 90 per cent is not very different from that of those taken in 1974, then such losses should be in the 9 to 11 per cent range.

These data and conclusions do not preclude the possibility that other factors may cause excessive losses in the swim-up stage. Other pesticides or toxic contaminants, changes in starter diet, disease or combination of these may be such factors. It is important to note that many lake trout in Lake George are carrying DDT residues in excess of the actionable levels set by the U.S. Food and Drug Administration, and many also have high PCB levels. Continued monitoring of this lake is desirable since such chemical combinations have a potential for causing future problems.

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FIRST RECORD OF THE FALLFISH FROM THE LAKE ERIE DRAINAGE OF NEW YORK¹

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The fallfish (*Semotilus corporalis*) is known to inhabit the waters east of the Appalachians from Virginia to New Brunswick and Quebec. Its northern range extends west to the James Bay region of Ontario and south to the north shore of Lake Ontario where it ends in the vicinity of the Trent River (Scott and Crossman, 1973). These authors showed that the record from the Lake Superior drainage of Ontario by Allin (1951), as cited by Hubbs and Lagler (1964) and quoted from the latter source by Reed (1971) and Raney (1969), was a misidentification of the creek chub (*Semotilus atromaculatus*).

In New York, it is widespread in waters draining into the St. Lawrence River as well as in other drainages that are tributary to the Atlantic Ocean, including the Susquehanna system. With respect to waters that flow into Lake Ontario and Lake Erie, however, Greeley (1940) found it in the eastern Lake Ontario basin, but he did not find it in the Genesee drainage (Greeley, 1927) or the Erie-Niagara system (Greeley, 1929). Also, Greeley (1938) did not find it in the Allegany drainage. Neither have fallfish been found in more recent collections in these western waters by personnel of the New York State Department of Environmental Conservation (William J. Abraham and Stephen R. Mooradian, personal communications, 1978).

In October and November of 1977, collections by the authors from the upper reaches of Tonawanda Creek in Wyoming and Genesee Counties included specimens subsequently identified as fallfish.² Individuals collected ranged from 40 to 99 millimeters in standard length and 0+ to 1+ in age suggesting successful reproduction and, hence, a presumably self-sustaining population. All the localities at which fallfish were taken also produced creek chubs. Another collection on May 4, 1978 from Tonawanda Creek 1.6 kilometers north of Attica in Genesee County included 32 fallfish² ranging from 43 to 133 millimeters in standard length and 0+ to 2+ in age. A 127-millimeter specimen possessed nuptial tubercles.

The origin of this population is uncertain. Movement from eastern Lake Ontario or its tributaries might have occurred via the Barge Canal, which forms the lower portion of Tonawanda Creek. However, the lower reaches of the creek where the canal connection exists are separated from the headwater sections where fallfish were taken by 4-meter-high Indian Falls which appears to be an impassable barrier to upstream movement. The most probable explanation seems to be transport and introduction through some human activity such as the operations* of bait dealers or bait-bucket transport by anglers. This would require the fish that developed into the original breeding stock to have been transported at least 55 kilometers, i.e., the distance to the closest point at which any other fallfish population is known to exist.

The significance of the establishment of a self-sustaining fallfish population in this locality cannot presently be assessed. In most areas where this species exists in contact with trout populations, it is considered to be an undesirable competitor or predator (Greeley, 1940; Raney, 1969; Reed, 1971; Scarola, 1973). By colonizing the Tonawanda Creek drainage, fallfish have successfully bypassed the major geographic

¹ The authors wish to thank C. May for field assistance and Dr. C. L. Smith of the American Museum of Natural History for identifying specimens. W. J. Abraham and S. R. Mooradian of the New York State Department of Environmental Conservation provided records from the files of Regions 8 and 9, respectively, and G. F. Mikol of the same department examined scales.

² Collections were donated to the American Museum of Natural History where those for 1977 are catalogued AMNH No. 36928 and those for 1978, AMNH No. 36942.

barrier, the Onondaga Escarpment and Niagara Falls, separating Lake Ontario from the remainder of the Great Lakes and have at least the geographic potential to spread throughout these waters.

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SEX RATIOS AMONG FAWN WHITE-TAILED DEER¹

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Sex ratios are among the important parameters for analyzing the structure of white-tailed deer (*Odocoileus virginianus*) populations. Such ratios for the over-all legal take by hunting are generally heavily weighted to males because of restrictions on taking antlerless deer. However, the proportion of males in the take is also probably somewhat inflated where seasons for deer of either sex are held because of a general desire on the part of hunters to take the larger, antlered bucks. Data

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² Retired.

for fawns probably represent the fundamental proportion of males to females in the increment recruited into the pre-hunting season populations annually.

Information on sex ratios among fawns, obtained chiefly during the hunting season, was compiled from several sources in 10 states during the 1940's and 1950's, and the average proportion, i.e., 106.2 males per 100 females, was reported by Severinghaus and Cheatum (1956). The assembled data was inadvertently never subsequently published and are presented in Table 1 as a matter of record.

TABLE 1. SEX RATIOS AMONG FAWN WHITE-TAILED DEER DURING THE HUNTING SEASON* AS REPORTED BY GAME TECHNICIANS IN VARIOUS EASTERN AND MID-WESTERN STATES

Source of information§	Number		Ratio (males per 100 females)
	Male	Female	
Massachusetts 1950-1953 (1)	590	540	109.3
Maine (2)	927	923	100.4
Michigan			
Hanson Refuge (3a)	204	226	90.3
Cusino Refuge (3a)	240	240	100.0
Camp meat permits (3b)	1,602	1,416	113.1
Hunting 1951-1953 (3c)	2,785	2,491	111.8
Minnesota			
State parks 1951-1953 (4a)	419	425	98.6
Checking stations 1953 (4b)	359	325	110.5
Checking stations 1954 (4b)	493	464	106.3
Non-hunting mortality 1951-1954 (4b)	236	232	101.7
Missouri (5)	418	414	101.0
New Hampshire 1948-1953 (6)	918	782	117.4
New York			
Checking stations (7a)	1,728	1,719	100.5
Highway mortality 1938-1950 (7b)	1,731	1,707	101.4
North Carolina (8)	477	459	103.9
West Virginia			
1950 (9a)	334	292	114.4
1951-1953 (9b)	2,521	2,427	103.9
Wisconsin (10)	4,257	3,978	107.0
Total	20,239	19,060	106.2

* Except for highway mortality in New York.

§ (1) C. L. McLaughlin, personal communication, January 27, 1955.

(2) Banaziak (1955).

(3a) McBeath (1941).

(3b) Michigan Department of Conservation (1942).

(3c) L. D. Fay, personal communication, February 4, 1955.

(4a) Arnold B. Erickson, personal communication, December 28, 1954.

(4b) V. E. Gunvalson, personal communication, January 5, 1955.

(5) Bohn and Robb (1955).

(6) David L. White, personal communication, February 2, 1955.

(7a) Compiled by junior author for 1943, 1944, 1948, 1950 and 1952.

(7b) Reported by state game protectors; all fawns, but includes summer and early fall records.

(8) Ruff (1938).

(9a) W. R. DeGarmo, personal communication, July 20, 1950.

(9b) John Gill, personal communication, December 27, 1954.

(10) James B. Hale, personal communication, February 4, 1955.

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NOTES ON FISHES RARE IN THE WATERS OFF THE SOUTH SHORE
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In the course of marine fishery investigations by Department personnel in the waters off Long Island (N.Y.), fishes rare to the area are recorded from time to time. Following are three such records from the south shore.

INQUILINE SNAILFISH

In 1974, the senior author (Briggs, 1974) identified two larval and three juvenile fish, taken at the Fire Island artificial reef in 1971 and 1972, as the seasnail (*Liparis atlanticus*). At the time, he was unaware of the description by Able (1973) of a new species, the inquiline snailfish (*Liparis inquilinus*). Re-examination of these specimens indicates (based on fin-ray counts, Table 1) that they are actually examples of the dark color phase of the inquiline snailfish and represent the first records for New York waters.

¹ Contribution No. 79-2 of the Division of Marine Resources.

TABLE 1. FIN-RAY COUNTS OF LIPARID FISH TAKEN AT FIRE ISLAND REEF COMPARED WITH DATA FOR THE SEASNAIL AND INQUILINE SNAILFISH

Date taken	Total length (millimeters)	Fin-ray count		
		Dorsal	Anal	Pectoral
Liparid specimens examined				
1971: June 16	12	35	29	35
June 16	13	35	30	35
1972: November 13	32	34	28	34
1972: November 16	33	33	28	33
November 16	36	35	28	35
1977: November 22	32	34	28	34
Comparative data as given by Able (1973)				
Seasnail		31-34	24-27	26-30
Inquiline snailfish		33-38	28-31	30-35

Able (1973) also described three other color phases of the inquiline snailfish, i.e., spotted, striped and mottled. None of these had been reported from New York waters until, on November 22, 1977, the author captured an example of the striped phase (chocolate brown stripes on a light tan base) in a fish trap at the Fire Island reef. The data for this specimen are included in Table 1.

COBIA

On Saturday July 22, 1977, an angler, Joseph Treola, caught a cobia (*Rachycentron canadum*) in the vicinity of West Fire Island in Great South Bay. He found the fish to be about 36 inches (915 millimeters) long and to weigh about 14 pounds (6.4 kilograms) and, upon cleaning it, noted that it had been feeding on silversides (*Menidia* spp.). The following Thursday he called the authors who confirmed his identification. To our knowledge, this is the first record of the species from Great South Bay, as well as the fourth adult and first taken by angling in Long Island waters.

Cobia are cosmopolitan in warm seas, but on the western side of the Atlantic they are not common north of Chesapeake Bay (Breder, 1948). The other six confirmed specimens from Long Island waters included three juveniles, one from Jones Inlet taken in 1925 (Nichols and Breder, 1926) and two previously unreported fish seined by Department personnel from Shinnecock Bay on August 15, 1976. The three adults comprised a 31-inch fish from New York Bay taken June 15, 1815 (Bean, 1903), a 36-inch fish from Gardiners Bay on August 8, 1938 and a 30-pound fish from Long Island Sound on August 8, 1946. The latter two, reported by Latham (1964), were caught in pound nets.

BONEFISH

On September 26, 1978, an adult bonefish (*Albula vulpes*), identification of which was confirmed by the authors, was caught by a commercial fisherman, Donald Bennett, in a gill net in approximately 12 feet of water off Fire Island ¼ mile east of the bathing pavilion at Smith Point County Park on the south shore of Long Island. The fish measured 603 millimeters in fork length (673 millimeters in total length) and weighed 3.3 kilograms.

Three days later another adult bonefish, taken on September 22, 1978 by Floyd Whistutz in a gill net off Gilgo Beach about 7 kilometers west of Fire Island Inlet, was brought to the attention of the Department. This fish measured 613 millimeters in fork length (711 millimeters in total length) and weighed 3.0 kilograms.

While bonefish are known from all warm seas (Breder, 1948) and stray as far north as the Bay of Fundy (Linkletter et al., 1977), they are extremely rare in New York waters, and few of any size have been reported. While Alperin and Schaefer (1964) seined an unprecedented 108 juveniles from Great South Bay in 1962, they found no adults. Bean (1903) mentioned a bonefish sent to him by Captain Thurber of Patchogue, but gave no indication of its size or the location and date of capture. Breder and Nigrelli (1934) reported a 2-foot (610-millimeter) bonefish from Long Island Sound in 1933. Latham (1964) reported two from Orient: a 21-inch (533-millimeter) fish taken on October 1, 1939 and a 14-inch (356-millimeter) fish taken on June 17, 1940. To our knowledge, no other bonefish have been recorded from New York waters, and the two reported here are the first confirmed records of adults from the south shore of Long Island.

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A SURVEY OF DEER ON THE SENECA ARMY DEPOT FOR EVIDENCE OF LEPTOSPIROSIS, BRUCELLOSIS AND TOXOPLASMOSIS

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The Seneca Army Depot in Seneca County (N.Y.) supports a population of white-tailed deer (*Odocoileus virginianus*) that has been isolated from domestic livestock and neighboring deer by a 7-foot-high fence constructed in 1942. This has afforded a unique opportunity for long-term studies of this population by the State Department of Environmental Conservation. The isolation also provides ideal conditions for examining the incidence of disease among deer uninfluenced by interactions with domestic animals. Deer and domestic animals have a variety of diseases in common. The nonspecificity of these diseases continually raises the question of the importance of deer as reservoirs for diseases of domestic animals, particularly cattle. In collaboration with the Department, the authors collected serological data concerning three such diseases in a limited sample of deer from the Depot in 1976.

Blood samples from deer of both sexes were collected from 36 hunter-killed deer during November 1976. Serum from each sample was tested for antibodies to leptospirosis (macro-agglutination test), brucellosis (card test) and toxoplasmosis (indirect hemagglutination test). The serotypes of *Leptospira* tested were *L. grippityphosa*, *L. hardjo*, *L. icterohemorrhagiae* and *L. pomona*. Minimum dilutions considered significant were 1:10 for *L. hardjo*, 1:40 for all other leptospiral serotypes and 1:64 for *Toxoplasma gondii*.

Sera from two deer were positive for *L. icterohemorrhagiae* (1:40), and that from another was positive for *L. pomona* (1:160). All samples were negative for the other leptospiral serotypes and *Brucella*. One sample was positive for *Toxoplasma* antibodies (1:64).

Leptospira and *Brucella* may cause abortion in many species of ruminants. Previous reports of *Brucella* in deer indicate a low incidence of antibody titers and minimal pathological effects (Witter and O'Meara, 1970). *Leptospira*, however, can cause abortion in deer (Trainer et al., 1961), and antibody activity has been reported to occur at incidences of 10 to 26 per cent for *L. pomona* (Roth, 1970). Incidences of antibody activity to other serotypes in deer do not appear to be as great as those for *L. pomona*. Data from the present survey indicate that *Leptospira*, *Brucella* and *Toxoplasma* were not commonplace in the deer population at the Seneca Army Depot and therefore not of concern to the ongoing studies of the population dynamics of this population at that time. The low incidence of these disease organisms also supports the belief that deer are not a primary reservoir of diseases of domestic animals. However, it must be recognized that the sample represented only a short time period and may not be representative of an isolated population over an extended period.

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